

Report of the
Bureau of Engineering
1924-1925

Department of Public Works

City and County of
San Francisco

M. M. O'SHAUGHNESSY
City Engineer

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REPORT OF THE BUREAU *of* ENGINEERING

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COUNTY OF
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DATED JUNE 30, 1925

REFERENCE BOOK

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Mayor

A. REARDON
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J. FRASER

Board of Public Works

M. M. O'SHAUGHNESSY
City Engineer



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REPORT
OF THE
BUREAU *of* ENGINEERING
OF THE
DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO

FISCAL YEAR ENDING JUNE 30, 1925

JAMES ROLPH, Jr.

Mayor

TIMOTHY A. REARDON

CHARLES E. STANTON

DANIEL G. FRASER

Board of Public Works

M. M. O'SHAUGHNESSY

City Engineer

*352.5

5a-52.2



HETCH HETCHY RESERVOIR

View looking east showing central three miles of reservoir. Kolano Rock (on right) rises 1800 feet above floor of valley. Raucheria Mountain in background.



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Report of the Bureau of Engineering

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF SAN FRANCISCO
1924-1925

To the Honorable
The Board of Public Works of the
City and County of San Francisco.

Gentlemen:—

I transmit herewith the annual report of the Bureau of Engineering for the fiscal year 1924-1925. In this report I have touched upon the main features of the engineering projects being planned or carried on in this City under my jurisdiction. No mention is made of the many routine details handled by this department—work which requires the time and services of many conscientious men. This work has increased in geometrical proportions with the rapid growth and progress of this City.

The increase in the vast amount of street work performed during the past few years reflects the solid growth of the City and is indicative of the increased proportionate amount of work for which this department has been responsible.

	Private	Public	City	Total
1921-22	\$ 282,585	\$363,244	\$169,397	\$ 815,227
1922-23	412,354	671,444	321,163	1,404,963
1923-24	520,612	485,830	452,153	1,458,595
1924-25	1,295,527	441,340	357,466	2,094,333

Improvements of streets under private contract permits have increased fourfold—the total amount of work performed under all forms of contract being more than doubled in the past four years. The performance of street work under private contract reduces the time necessary for proceedings preliminary to the actual construction. Under normal conditions, the private contract system would also relieve this office and various other departments of the City from a large amount of detail, such as drawing up proceedings, advertising, preparing assessments, etc. Due to the activities of certain solicitors and contractors engaged in street improvements, the Board of Supervisors, acting adversely to my recommendation, passed a new ordinance controlling the issuing of permits for street work under private contracts, and removed restrictions imposed by this office. As a result and with the generous use of this form of contract, the amount of preliminary work necessary in this department for the improvement of streets—including but one feature of our work—has been greatly increased.

Since the close of the fiscal year and while this report has been in preparation, important developments in connection with several major projects herein described have taken place.

Bottleneck on Peninsula Highway—A solution of the problem of widening the narrow Peninsula Highway for 7500 feet south of Colma, popularly known as "breaking the bottle-neck," has been reached through cooperation by this department. Under the proposed plan a highway, 124 feet in width, will be constructed from Colma southerly past the Cemeteries. The estimated cost of this work, exclusive of rights of way to be given by Cypress Lawn Cemetery Association, is about \$506,500, to be divided as follows:

State of California.....	\$250,000
City and County of San Francisco.....	150,000
San Mateo County.....	50,000
Market Street Railway Company.....	56,500

Duboce Tunnel—The Sunset Tunnel (Duboce Avenue Route) is assured. Bids were received on May 5, 1926, and the contract for the construction was awarded on May 10th to the lowest bidder, Youdall Construction Company (Leonard F. Youdall and R. G. Clifford) for the estimated sum of \$1,247,592. Ground was broken at the East Portal on June 10th and work is now progressing.

Municipal Railway—A contract for the section of the Municipal Railway line on Judah Street between Thirty-first and Forty-first Avenues, which is now being paved, has been awarded, and construction of the tracks on this section will be completed before new pavement is laid on the portion of the street reserved for the car line.

Hetch Hetchy Power—Moccasin Power Plant on the Hetch Hetchy project has been in operation since August 14, 1925, and the electric power is being delivered to the Pacific Gas and Electric Company's substation near Newark, at present the terminus of the City's transmission line. A contract has been entered into between the City and the Company, wherein the Pacific Gas and Electric Company is temporarily employed as the City's agent in distributing the power output. For the output of the plant during the eleven months in which the contract has been in force, \$1,993,965 has been added to the City's revenue, this being at a rate somewhat in excess of \$2,000,000 annually.

Local Water Supply—Water impounded by the Spring Valley Water Company in Alameda County has been flowing through the Bay Development pipe line and Pulgas Tunnel into Crystal Springs Lake since September 14, 1925. Connection was made with the Company's line between Niles and Irvington and also with their submarine pipe lines across Dumbarton Straits. At Dumbarton, this water was pumped through the City's aqueduct through Pulgas tunnel 292 feet high into Crystal Springs Lake. Since completion of the City's 42-inch diameter cast-iron submarine pipe under Dumbarton navigable channel, the pipe line has been used to a

fuller capacity. The City is now receiving the full amount of the \$250,000 per annum which the Spring Valley Water Company is to pay for temporary use of the Bay Crossing aqueduct.

Faithful service to the City has been given by the municipal employees of this Department. Their loyalty to me and to the City through many periods of civic strife and unsettled conditions is to be commended. I feel deeply the loss by death during recent years of many esteemed members of my staff.

Respectfully submitted,

M. M. O'SHAUGHNESSY,
City Engineer.

**EMPLOYEES
OF
BUREAU OF ENGINEERING
1925**

M. M. O'Shaughnessy	City Engineer.
N. A. Eckart	Chief Assistant Engineer — H e t c h Hetchy Water Supply Project.
C. E. Healy	Second Assistant City Engineer—Gen- eral City Engineering.

General Office:

W. A. Smith, Sr.	Engineering Draftsman.
A. W. Garbarino	Field Assistant.
J. A. Hourigan	Chauffeur
Mrs. A. M. Osswald	Stenographer.
Miss K. F. Sears	Stenographer.
Miss A. Kelly	Stenographer.

Special Assignments:

F. E. Hackney	Engineering Draftsman.
---------------	------------------------

**Division of Design: Structures, Sewerage, Tunnels, Special Improvements,
High Pressure System:**

W. H. Ohmen	Engineering Draftsman—In Charge.
M. H. Levy	Assistant Civil Engineer.
B. Silberberg	Assistant Civil Engineer.
L. B. Cheminant	Engineering Draftsman.
J. C. Gard	Engineering Draftsman.
J. O. Hanson	Engineering Draftsman.
L. G. Tegtmeyer	Engineering Draftsman.
W. N. Buckley	Engineering Draftsman.
B. A. Baird	Engineering Draftsman.
M. D. Johnson	Engineering Draftsman.
M. J. Callaghan	Engineering Draftsman.
A. V. Bowhay	Engineering Draftsman.
C. V. Patterson	Engineering Draftsman.
A. L. Auradou	Cartographer.
R. E. Surryhne	Inspector.
F. A. Sullivan	Inspector.

Division of Street Improvement Design and Diagrams:

J. M. Owens	Engineering Draftsman—In Charge.
H. L. Reinfeld	Engineering Draftsman
J. J. Schlappi	Engineering Draftsman
E. A. Burke	Surveyor.
T. C. Ronan	Field Assistant.
W. J. Walsh	Inspector.

Division of Street Improvement Permits and Investigations:

W. C. Pidge	Assistant Civil Engineer.
L. R. Mercado	Inspector.
E. I. Titlow	Inspector.

Division of Street Improvement Assessments and Complaints:

E. E. Jordan	Field Assistant—In Charge.
I. Schwartz	Experienced Clerk.
Miss M. E. Sullivan	Stenographer.
A. A. Flynn	Inspector.
W. H. McCarthy	Inspector.
E. E. McCartney	Inspector.
L. C. Whaley	Inspector.
C. I. Sullivan	Inspector.
P. Williams	Field Assistant.
W. A. Lewis	Field Assistant.

Division of Street Grades:

G. F. Stahl	Surveyor—In Charge.
W. A. Smith, Jr.	Field Assistant.

Division of Construction:

F. O. Shutts	Assistant Civil Engineer—Supervising Street and Sewer Construction.
C. M. Taylor	Inspector—Supervising Major Project Construction
L. Glick	Assistant Civil Engineer—Office En- gineer.
E. Muheim	Engineering Draftsman.
J. J. Casey	Engineering Draftsman.
P. C. O'Dowd	Inspector.
W. Fisher	Inspector.
T. Tominski	Inspector.
J. D. Coon	Inspector.
I. A. Sankey	Inspector.
F. J. Lewis	Inspector.
C. W. Otwell	Inspector.
C. J. Geertz	Inspector.
A. L. Scroggy	Inspector.
J. A. Ducray	Inspector.
W. H. Williams, Jr.	Inspector.
E. L. Gartland	Inspector.
C. J. Manelli	Inspector.
H. J. Law	Inspector.
A. P. Mallon	Inspector.
L. T. Curran	Inspector.
J. B. West	Inspector.
J. H. Flynn	Field Assistant.

Division of Surveys:

H. J. Stahle	Surveyor—In Charge.
A. D. Phares	Surveyor
J. Schlotzhauer	Surveyor
F. W. Knox	Surveyor
I. Flamm	Surveyor
W. H. Eggert	Surveyor
C. H. Stern	Surveyor
J. F. Coughlan	Surveyor
E. A. Garen	Surveyor
W. T. Lundy	Surveyor
J. O. Meyerink	Engineering Draftsman.
S. M. Jarrett	Inspector.
J. C. Garbarino	Field Assistant.
J. W. Farnham	Field Assistant.
D. R. Hult	Field Assistant.
A. Olsen	Field Assistant.
L. E. Fenton	Field Assistant.
W. J. Hatman	Field Assistant.
C. A. Gardiner	Field Assistant.
C. Jones	Field Assistant.
G. R. Code	Field Assistant.
H. Miller	Field Assistant.
N. A. Giberson	Field Assistant.
R. G. Banks	Field Assistant.
R. Grier	Field Assistant.
C. C. Dennis	Field Assistant.
W. F. Kaiser	Field Assistant.
R. L. McHugh	Field Assistant.
T. J. Canty	Field Assistant.
C. S. Hiden	Field Assistant.
A. J. Abrahamsen	Field Assistant.
T. E. Moroney	Field Assistant.
S. B. Carlson	Field Assistant.
J. L. Slater, Jr.	Field Assistant.
C. J. Muller	Field Assistant.
G. W. Miller	Field Assistant.

Land Purchases:

J. J. Phillips	Right of Way Agent—In Charge.
E. J. Riordan	Engineering Draftsman.

Chemical and Testing Laboratory:

C. L. Cook	Engineering Chemist—In Charge.
P. Bernard	Engineering Chemist's Assistant.

Blueprinting and Photographic Division:

H. B. Chaffee	Photographer—In Charge.
H. Adami	Photostat Operator.
H. B. Dodge	Blueprinter.

Electrical and Street Railway Engineering:

P. J. Ost	Electrical Engineer—In Charge.
T. Easler	Assistant Electrical Engineer.
O. M. Prince	Assistant Mechanical Engineer.
F. J. Sheehan	Assistant Mechanical Engineer.
I. J. Ohman	Assistant Civil Engineer.
C. A. Hoffman	Engineering Draftsman.
L. M. Perrin	Electrical Draftsman.
W. S. Levin	Electrical Draftsman.
J. D. Hatch	Architectural Draftsman.
L. Constine	Architectural Draftsman.
L. V. Degnan	Inspector.
J. H. Hanly	Inspector.
F. Keville	Inspector.
F. F. Buhr	Engineer, Hoisting and Portable Engines.

Mechanical Engineering—H. H. W. S. Project:

E. P. Jones	Mechanical Engineer.
-------------	----------------------

Hydraulic and Civil Engineering—H. H. W. S. Project:

L. W. Stocker	Assistant Civil Engineer.
R. P. McIntosh	Hydraulic Engineer.
M. J. Bartell	Hydraulic Engineer.
R. L. Allin	Hydraulic Engineer.
W. W. Helbush	Assistant Mechanical Engineer.
E. Burjan	Engineering Draftsman.
E. P. Cutting	Engineering Draftsman.
R. Williams	Engineering Draftsman.

General Office—H. H. W. S. Project—Purchasing and Correspondence:

H. W. Kephart	Stenographer - Bookkeeper — In Charge.
W. A. Robison	Stenographer.
L. Cederberg	Stenographer.

IN MEMORIAM**HARRY H. HOLLIDGE**

Surveyor

Service—23 years

Died—November 26, 1923

RICHARD W. O'CONNOR

Inspector

Service—17 years

Died—August 18, 1924

CHARLES R. BROWN

Assistant Construction Engineer

Service—4 years

Died—September 2, 1924

CARL HILPISCH

Surveyor

Service—20 years

Died—March 12, 1925

WILLIAM J. TURNER

Inspector

Service—24 years

Died—May 5, 1925

REUBEN J. WOOD

Structural Engineer

Service—17 years

Died—October 15, 1925

JAMES A. RILEY

Assessment Clerk

Service—13 years

Died—October 17, 1925

PROJECTS AND INVESTIGATIONS

Many large projects have been initiated during the past years by this department and have been presented for attention of the public. This department has therefore set forth in the following letter to the City Planning Commission a list of and data concerning projects which are considered as of immediate necessity:

"June 18, 1925.

City Planning Commission,
City Hall,
San Francisco, Cal.

Gentlemen:—

I transmit herewith a list of projects which I recommend that you include with the request you intend to make to the Board of Supervisors in regard to projects of importance to San Francisco:

- | | |
|--|------------|
| 1. Glen Park Reservoir Site—acquisition of
balance, 74.51 acres | \$ 180,000 |
| 2. Amazon Reservoir—Construction | 2,500,000 |
| 3. San Francisco Bayshore Boulevard | 1,750,000 |
| 4. Panhandle Extension to Market Street..... | 3,000,000 |
| 5. Bernal Cut | 1,400,000 |
| 6. Ocean Shore Right of Way—Widening.... | 180,000 |
| 7. Sutro Mountain Park—75 acres | 150,000 |
| 8. Van Ness Avenue Extension | 700,000 |

Total	\$9,860,000
-------------	-------------

1. **Glen Park Reservoir Site**—74.51 acres remaining, situated in Stanford Heights just southerly from Twin Peaks, should be acquired at the earliest possible date. This reservoir has a total acreage of 184.3 acres, including streets. Will provide a capacity of 500 million gallons.

2. **Amazon Reservoir Construction**, lands for which have been practically acquired, is situated in the Amazon tract, close to the County line, is 52.9 acres in extent, and will provide 300 million gallons capacity. The construction of the necessary dam and appurtenances to impound the water should be started at once.

3. **San Francisco Bayshore Boulevard** extends from Army Street and San Bruno Avenue to the County line, and will be 125 feet wide, 3 miles long. This boulevard will penetrate a portion of the industrial district of San Francisco which is rapidly coming to the front, and the land required for the boulevard should be condemned at as early a date as possible. This boulevard will connect with the Bayshore Boulevard, extending from the County line; and projected to go clear to San Jose under the State Highway program.

4. **Panhandle Extension to Market Street** will be practically an extension of the existing panhandle of Golden Gate Park from Baker Street easterly and southeasterly to a point close to Dolores and Market Streets. It will be 200 feet wide, 4600 feet long, and will provide a low

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GOLDEN GATE

YACHT HARBOR

AQUATIC PARK

DELEGNATE PARK

PRESIDIO

U.S. MILITARY RESERVATION

MAP

OF THE
CITY AND COUNTY OF

SAN FRANCISCO

1925

M.M.O'SHAUGHNESSY

CITY ENGINEER

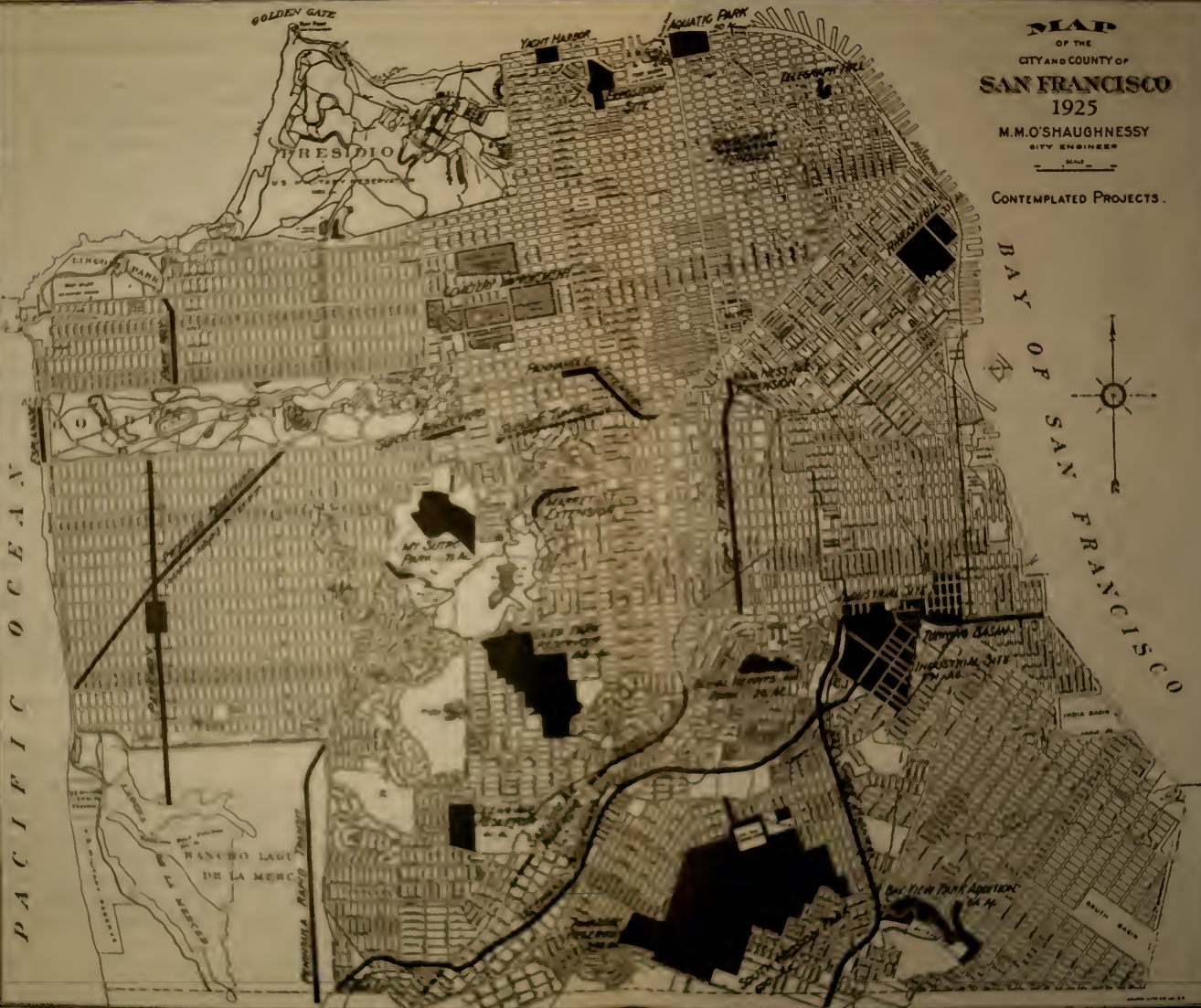
SCALE

CONTEMPLATED PROJECTS.

BAY OF
SAN FRANCISCO



PACIFIC OCEAN



grade route for vehicular traffic to Golden Gate Park and adjacent districts.

5. **Bernal Cut**, extending from Dolores St. and San Jose Ave. to San Jose Ave. and Diamond St.—a length of 4200 feet, and a width of 117½ feet at the bottom of the cut. This will provide for a 42-foot roadway, two tracks for the Southern Pacific Company, and two tracks for the Municipal Railway. It will connect with the San Jose Avenue widening project which is under way, and provide another low grade route through the City and down the peninsula.

6. **Ocean Shore Right of Way Widening**. It is important that, in addition to the right of way received from the Ocean Shore Railway Company—60 feet in width—additional lands be acquired to widen it to 100 feet from San Bruno Avenue to Onondaga Avenue, and 80 feet from Onondaga Avenue to the County line. This will also provide another boulevard with a low rate of grade down the peninsula and into the heart of the city.

7. **Sutro Mountain Park**, surrounding Mount Sutro, would provide another high level park which could be encircled by a boulevard similar in character to the Twin Peaks Boulevard, providing a magnificent view of the entire City and Bay region.

8. **Van Ness Avenue Extension** should at this time be extended to Howard Street, as values in this district are rapidly increasing, and any delay almost destroys the prospect of a possible extension within reasonable bounds. At this time \$130,000 has been provided in the budget for a first payment on lands extending from Market to Mission Street, and I recommend that the entire extension be provided from Market to Howard Street, including the balance of payments necessary on the extension from Market to Mission Street.

All of the above projects are of immediate necessity, but I call your particular attention to the necessity for constructing the Amazon Reservoir, and for the acquisition of lands for the Glen Park Reservoir, number 1 and number 2 in the above list.

I attach hereto map showing the location of the projects listed.

Very truly yours,

(Signed)

M. M. O'SHAUGHNESSY,
City Engineer."

Descriptions of most of these desired improvements have been given in previous reports.

The two reservoirs, one in Glen Park and one in the Amazon Tract are important features in the municipal water supply system now being projected by the City. The present distributing reservoirs of the Spring Valley contains 125 million gallons, or consumption for three days' domestic use. I desire storage of one billion gallons in stock at high levels.

Surveys have been made and details are being planned for the section of Bay Shore Boulevard within the City and County of San Francisco. The City has contributed \$500,000 toward construction of sections in San

Mateo County, and the grading of $5\frac{1}{2}$ miles between South City and Burlingame is under way.

The following recommendation was made in the budget requests for the ensuing year submitted by this department:

"Bernal Cut: A substantial sum should be appropriated towards the Bernal Cut project. The Bernal Cut improvement has been considered by this department since before 1913 when, in granting a new franchise to the Southern Pacific Railway Co., it was stipulated that the City be granted a right of way through the existing Bernal railway cut. The necessary grading to accommodate a paved roadway was also made an obligation of the railroad company. The proposed plan provides a clear width of 117 feet 6 inches at the bottom of the cut, allowing for a 42-foot roadway, a double track street railway line, a double track interurban line of the Southern Pacific Company, and an eight-foot sidewalk. The cost of this improvement is now estimated at \$1,400,000, being \$550,000 for property and \$850,000 for the improvement, exclusive of the grading to be done by the railroad company. This estimate is about double the original estimate due to the increased costs of property, labor, and material. It is hoped that there will be no further delay in appropriating the funds for this work."

In response to this request, the sum of \$100,000 has been allocated in the budget for the ensuing year towards necessary property acquisitions on Bernal Cut project. Plans have gradually been developed for this improvement, special attention having been given to treatment of the various intersecting thoroughfares and also to the general type of structure to bridge the cut.

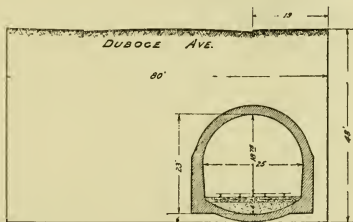
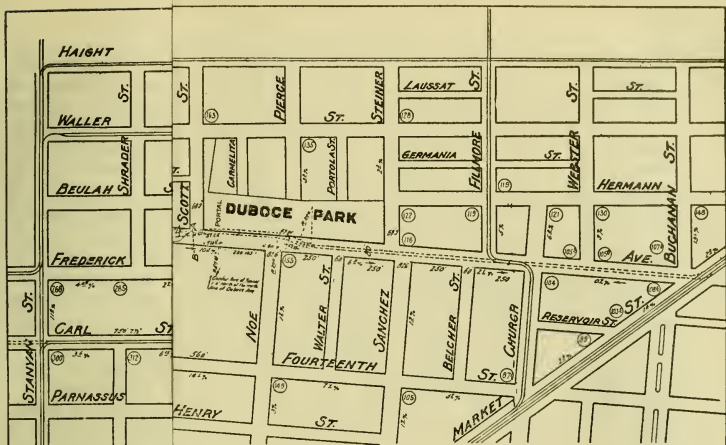
The City has acquired the right of way of the Ocean Shore Railway Company from San Bruno Avenue to the County line. It is planned to construct a boulevard along this strip of land connecting the proposed Bay Shore Boulevard and Junipero Serra Boulevard. As stated in the above letter, additional lands are needed in order to provide sufficient width of roadway. Preliminary studies for connections with the proposed boulevard at San Jose Avenue, Sickles Avenue, Plymouth Avenue and Mission Street are being made.

The necessary lands for the extension of Van Ness Avenue to Howard Street will be acquired with the monies allowed in the annual budgets of the City; the sum of \$130,000 is included in the budget under consideration for this coming year. This sum will cover one-third of the cost of the land for the first block from Market Street to Mission Street, negotiations now being under way for this purchase to be paid for in annual installments. The cost of improving the street will be borne by the property directly fronting thereon.

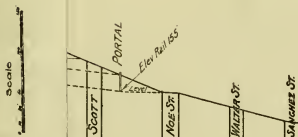
Sunset Tunnel:

The Duboce Avenue Route recommended by this office was approved on April 6, 1925, by the Board of Supervisors after protracted political discussion.

A suit filed by antagonists of this project to restrain the City from proceeding has been decided in favor of the City. No doubt, as usual in such public improvements, an appeal will be taken by the obstructionists.



Cross-Section A-B
Scale 1 in = 10 ft.



Scale
1 in = 10 ft.

REVISIONS	CITY AND COUNTY OF SAN FRANCISCO DEPARTMENT OF PUBLIC WORKS BUREAU OF ENGINEERING M. M. O'BRIEN CHIEF CITY ENGINEER		
REFERENCES <i>Survey 4447-M</i>	SUNSET TUNNEL (DUBOCE AVENUE ROUTE) PLAN, PROFILE AND CROSS SECTION SHOWING THE GRADIENTS OF TUNNEL AND APPROACHES. SCALE <i>1 in. = 2' HORIZ. 1" = 10' VERT.</i>		
DESIGNED BY <i>J. C. B.</i>	IN CHARGE <i>W. H. McLaughlin</i>	SHEET NO. <i>574</i>	FILE <i>B-6026</i>
TRADED BY <i>J. H. N.</i>			
PRINTED BY			

Meanwhile the assessment rolls have been prepared in this office and forwarded to the Tax Collector who will institute proceedings for the collection of the assessments. Bids on the construction of this tunnel will probably be received in May, 1926.

The Sunset Tunnel will afford direct and rapid transportation service to approximately 1200 acres of Sunset district south of Golden Gate Park. It will save at least eight minutes in time between the west portal of the proposed tunnel and Third and Market Streets over the time necessary for the same trip with the only present available railway service.

The cost of necessary lands for approaches and easements and of the construction of the tunnel and for incidentals will be assessed on a district with an area of 1129 acres. This embraces the whole of the territory which will receive maximum direct benefit from this project through development, and is situated to the west of the Buena Vista ridge through which the tunnel will penetrate.

The tunnel will begin at the southwest corner of Duboce Park, adjacent to Scott Street, and will extend under the elevation upon which is situated Buena Vista Park to a point close to Cole and Carl Streets. It will be a double track structure, resembling very closely in section the present Twin Peaks Tunnel. Surface indications and test borings point to a good hard rock formation for a major portion of the tunnel. Size, cost and assessment figures are contained in the following table:

Sunset Tunnel (Duboce Avenue Route)

Length of tunnel—portal to portal	4232 feet
Width of tunnel	25 feet
Height of tunnel—above rail	18 ft. 9 in.
Grade	3%

Estimated Cost:

Tunnel and approaches construction.....	\$1,401,704.60
Engineering	50,000.00
Collection	50,000.00
Contingencies	57,210.91

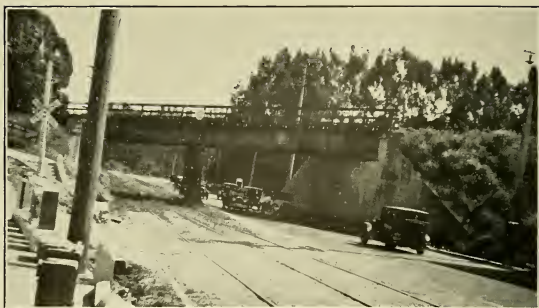
\$1,558,915.51

Lands to be taken in fee simple.....	89,153.00
Easements to be acquired.....	3,920.00

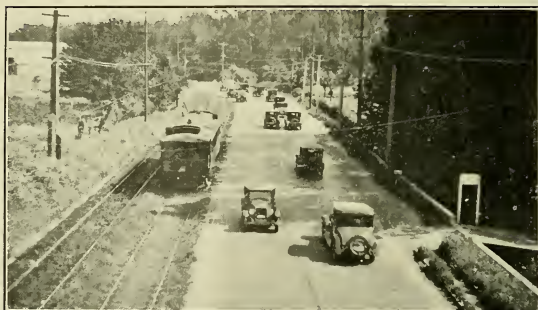
Total estimated cost\$1,651,988.51

Assessment district:

Area	1129 acres
Number of Parcels.....	9328
Number of Blocks.....	371
Assessment Rate—per square foot maximum.....	5c
per square foot minimum.....	1½c
Assessment on 25x125 ft. lot—maximum.....	\$150
minimum	\$45
Time to complete	15 months



SAN FRANCISCO-SAN MATEO HIGHWAY



Narrow paved strip with adjoining tracks on "Bottleneck" section of most heavily traveled highway out of San Francisco.



Peninsula Highway Widening:

A committee appointed by the Governor of California for the purpose of making a survey of the roads and highways of the State, in its report stated that the present Peninsula Highway out of this City passing over Colma hill and through the cemeteries in San Mateo County is the most congested piece of highway in the State.

Constructed on a 66 foot right of way, with tracks of the Market Street Railway Company occupying the easterly one-half of the right of way, a 24 foot wide paved strip is forced to accommodate the bulk of the traffic to and from this City. A count of the traffic on the Peninsula Highway at San Bruno on Sunday, June 15, 1924, showed 27,577 automobiles passing in 16 hours. The majority of these had to pass through the "bottle-neck" at the cemeteries, as very few take the Bayshore Road through South San Francisco. This latter road is not only narrow, hilly, and with many sharp curves, but does not lead directly to the residence portion of the City, where the holiday traffic originates. When completed, the Skyline Boulevard will receive some of the traffic but this is offset by the natural increase in the number of automobiles and amount of traffic.

Negotiations are being carried on between the State Highway Department, the Market Street Railway Company, the various Cemetery Associations, the Boards of Supervisors of San Mateo County and of this City, and this department, leading to the widening of this stretch of road.

The solution of this problem is of greatest importance to the City and the Peninsula territory and has been sought by this department for some time. It is hoped that the various interests concerned will adopt the proposed plan and allow of speedy accomplishment of this improvement.

Bay View Industrial District:

Preliminary data and information was gathered and prepared for a proposed industrial development of 264 acres in the Bay View District south of South Basin and east of Alvord Street. The estimated cost of necessary sea walls and fills is approximately \$3,000,000.

A bill, known as South Basin Canal Reclamation Act, introduced at the last State Legislature, and having as its object the reclamation of this and adjacent area to south, failed of passage but will undoubtedly be up again for consideration at a future session.

Islais Creek Reclamation District:

The formation of the Islais Creek Reclamation district, as provided for by a special act of the State Legislature, April 6, 1925, has been accomplished. The reclamation of 291 acres of swamp and lowlands for commercial and industrial uses is the aim of this project. Dredging and widening the deep water channel of Islais Creek, constructing 2000 feet of sea wall between the Southern Pacific main line and Third Street, and filling in over 2,500,000 cubic yards of material in the large area

of lowland are the main construction features of the reclamation program. Colbert Caldwell, M. M. O'Shaughnessy and Stuart F. Smith have been appointed trustees to serve the district.

Rincon Hill Regrade:

Failure of the "syndicate" plan suggested by the Chamber of Commerce, due to the opposition of certain property owners, has confirmed the opinion of the City Engineer that the proper method of financing the Rincon Hill regrade project is by means of an assessment district, as initiated and recommended by this office. A supplementary report on this project embodying the essential data of an assessment plan has been prepared by this office and submitted to the Chamber of Commerce for their support.

Miscellaneous Studies and Investigations:

Plans for a yard for the Department of Street Cleaning located at Jones and Jefferson Streets were prepared. A ramp and loading platform and garage for equipment were features of the design.

Also plans and specifications were issued for a transfer station for street sweepings and a garage for street cleaning equipment to be located in the Park-Presidio District.

A pedestrian subway under the Great Highway from the Beach Chalet to the Esplanade was designed for the Park Commission.

Sketches, specifications and supervision have been furnished when necessary on the maintenance, repair and painting of the various bridges controlled by the City.

Investigations and studies for the elimination of the old wooden approach and design of proper bulkheads for the Harrison Street Bridge over Beale Street were made.

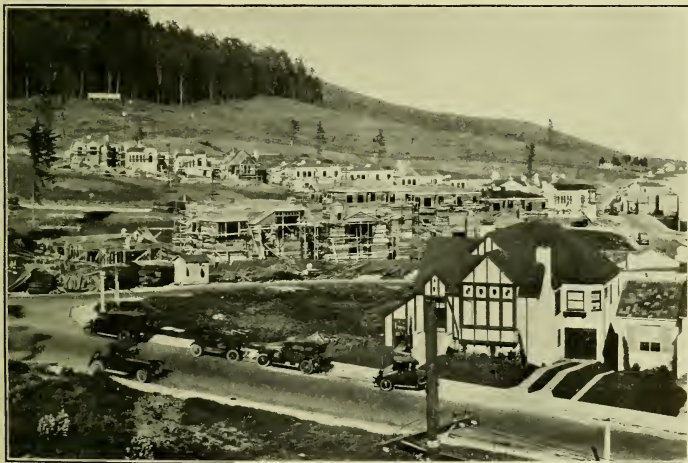
In response to the complaints of shipping interests in regard to the hours during which the bridges over Islais Creek and the Channel are closed to navigation, investigation of traffic conditions at these bridges have been made and recommendation outlined for consideration by the various public service corporations, shipping interests and others interested.

Strengthening and repair of the structural steel arches for illuminating purposes at the intersections on Fillmore Street was carried on by the district improvement club after investigation by this department disclosed the necessity for such repairs.

Various devices for eliminating boiler scale without the use of compounds are being investigated. The economic importance of this investigation is evident when it is known that the Civic Center power plant uses compound at a cost of \$900 per year for clearing the boilers of scale.



Recently improved residential tract showing street layout and improvement.



Construction of homes rapidly following completion of pavements. Within a year, this site was transformed from a barren hillside to a well built-up residential district.

RESIDENTIAL TRACT DEVELOPMENTS

BOULEVARDS, STREETS AND HIGHWAYS

During the past two years many large residential tracts were opened, resulting in a large amount of street improvements mostly under private contract permits granted by the Board of Public Works. The cost of street improvements completed during the last fiscal year in this City was approximately \$2,000,000, over 60% of which was done under private contracts. All street improvements to be accepted and maintained by the City are done under specifications, diagrams and inspection of this department. In addition, surveys and diagrams were furnished for reconstruction work of the Bureau of Street Repair amounting to \$365,000.

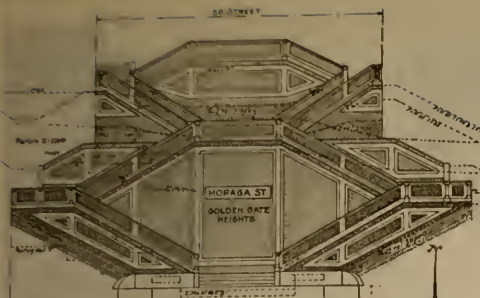
Special Treatment Improvements:

As real estate values throughout the City have risen, lots on hill-sides heretofore considered inaccessible have become valuable enough to demand improvement of thoroughfares leading to them. These improvements involving concrete walls and steps, double roadways, etc., each requires special designs and extensive studies in this department. In some cases, although the improvement in itself may not have been of great magnitude or cost, the necessary outlay for surveys, studies and plans to obtain the best and most economical results have been considerable. In many instances plans must be modified to fit ideas and schemes of the owners of the property involved. The great number of automobile owners add to the problems by requiring easy access to their garages from the street.

The largest single project involving special treatment under consideration during this past year is the **Golden Gate Heights** improvement. The details of the realignment of streets and resubdivision of the property in this district have been described in previous reports. Under this alignment the maximum street grade is 15%, whereas under the original rectangular gridiron plan the grades ranged from 20 to 43% with cuts necessary to obtain these grades as great as 92 feet.

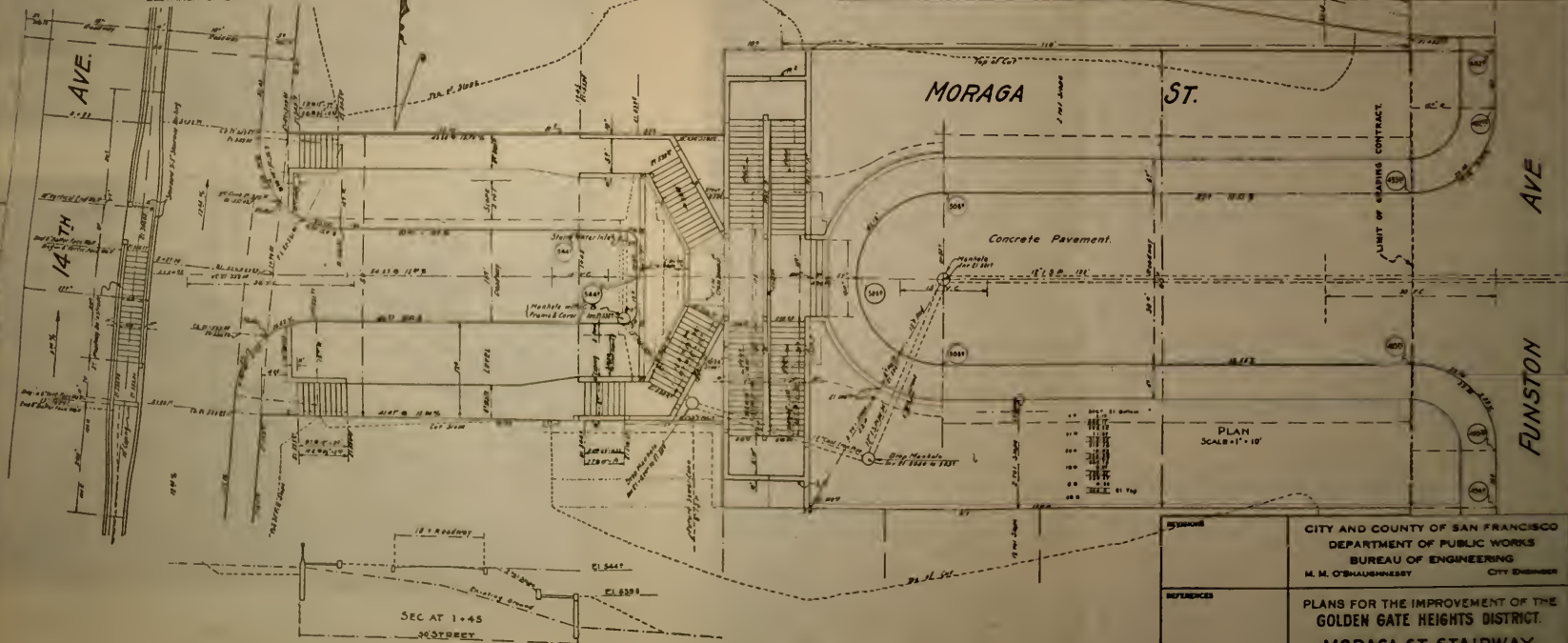
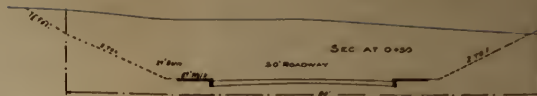
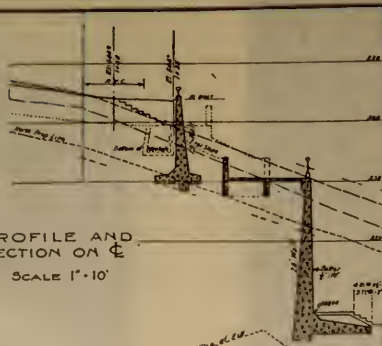
Some of the estimated quantities involved in this project are as follows:

Area of district.....	4,555,700 sq. ft.
Length of streets.....approx.	5 miles
Maximum grade.....	15 %
Maximum cut.....approx.	15 feet
Grading—cut including slopes.....	288,000 cu. yds.
Grading—fills	132,000 cu. yds.
Concrete walls and stairways.....	6,575 cu. yds.
Reinforcing steel.....	643,000 lbs.
Paving	1,075,500 sq. ft.
Curbs	70,500 lin. ft.
Sidewalk	272,300 sq. ft.
Sewers	170,000 lin. ft.
Cost	\$1,037,000



ELEVATION OF STAIRWAY

PROFILE AND SECTION ON C
SCALE 1"=10'



NOTE: For Wall elevations see Sheet No. 2

SYMBOLS	CITY AND COUNTY OF SAN FRANCISCO DEPARTMENT OF PUBLIC WORKS BUREAU OF ENGINEERING M. M. O'SHAUGHNESSY CITY ENGINEER
REFERENCES	PLANS FOR THE IMPROVEMENT OF THE GOLDEN GATE HEIGHTS DISTRICT. MORAGA ST. STAIRWAY
DRAWN BY CHECKED BY APPROVED BY	SCALE IN 24 SHEETS SHEET NO. 45 DATE JAN 25, 1924 FILE 1-6532



Twenty-first Street, from Castro Street to Collingwood Street.



Twenty-second Street, from Castro Street to Collingwood Street

COLLINGWOOD, TWENTY-FIRST AND TWENTY-SECOND STREETS SPECIAL
TREATMENT IMPROVEMENT.

Complete plans and specifications have been prepared and are ready for approval of the Board of Public Works under regular street improvement procedure.

Another large project being developed is the improvement of **Grand View Avenue** for its full length, involving considerable retaining wall work and estimated to cost \$130,000.

Liberal aid has been given by the City towards several local district improvements requiring special treatment, where the cost of the work, if assessed to private property, would be confiscatory. The Board of Supervisors has already pledged the City for half the cost of grading and paving of **Douglass Street between Twentieth and Twenty-first Streets**, and necessary plans for this special treatment are ready. Proceedings leading to a contract for this work will be inaugurated provided the sum of \$21,500 for the City's share is allowed in the budget.

Other special treatment improvements, either under way or being prepared during the year, were:

Havens Street, Leavenworth Street to westerly termination.

Vulcan Street, Ord Street to Levant Street.

Chestnut Street, Polk Street to Larkin Street.

Coso Avenue, Prospect Avenue to Winfield Street.

Detroit Street, Monterey Boulevard to Joost Avenue.

Elk Street, Bosworth Street to Glen Avenue.

Vallejo Street, Mason Street to Taylor Street.

Vermont Street, Twentieth Street to Twenty-second Street, and

Twenty-first Street, Vermont Street to Kansas Street.

La Salle Avenue, Lane Street to Mendell Street.

Paving was placed on **Collingwood, Twenty-first and Twenty-second Streets**, thus completing this special treatment improvement, the grading and walls having been done under a previous contract.

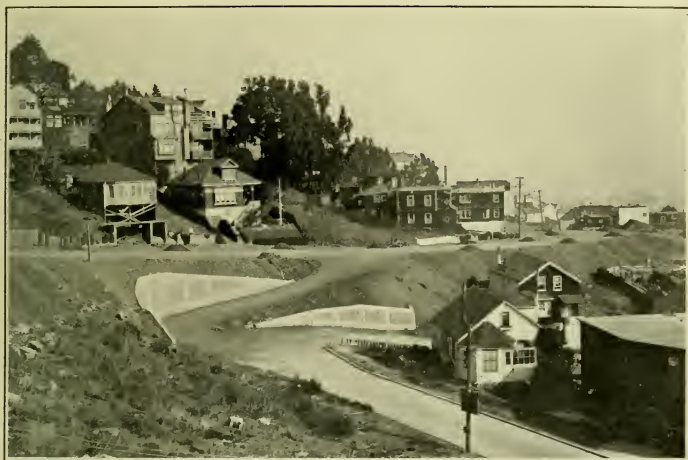
Civic Center Improvement:

Plans and specifications for improvement of the Civic Center park with a specially designed brick and granite pavement on a concrete base were prepared by this department for the Bureau of Architecture. The concrete base and necessary sewers and drainage facilities have been constructed in accordance with these plans.

The purchase of additional property for the Civic Center at **Fulton and Market Streets** permitted the paving of the intersection of **Fulton, Leavenworth and Market Streets** to be completed. At present **Leavenworth Street** does not run to **Fulton Street** but will be extended when the necessary property is purchased. A pavement has been laid over a temporary route from the end of **Leavenworth Street** through Civic Center property.

Roosevelt Way:

The grading and construction of walls and sewers on **Roosevelt Way** from **Fourteenth Street** to **Clayton Street** is proceeding under a



General view of road, showing side walls and ramp connection with Levant and States Streets

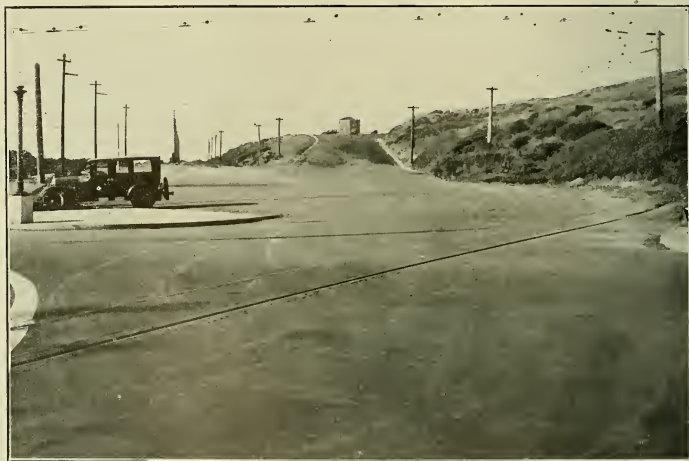


Retaining wall and double roadway serving upper and lower elevations on side hill.
ROOSEVELT WAY.

contract awarded May 11, 1925, for the estimated sum of \$67,405.76. This boulevard will connect the Pope Tract with the Market Street business district over an easy gradient—the maximum grade being about 10%. A 48-foot roadway with 6 foot walks on both sides is being graded. 27,000 yards of earth will be moved and the construction of retaining walls will require 1500 cubic yards of concrete.

Camino del Mar (Lincoln Park Boulevard):

The grading and macadamizing of a scenic drive in Lincoln Park from the Legion of Honor Memorial Building around the cliffs of the Golden Gate was completed. This section of drive, 4200 feet in length, was graded to a minimum width of 60 feet with a 40 foot macadamized roadway. This boulevard crosses an old slide originating at Fort Miley



EL CAMINO DEL MAR

View looking northerly from intersection of 48th and Point Lobos Avenues, showing westerly termination of boulevard through Lincoln Park.

and moving northerly toward the ocean. All possible precautions against accelerating the slide movement were taken by the City Engineer, and accurate observations of the rate are now being made.

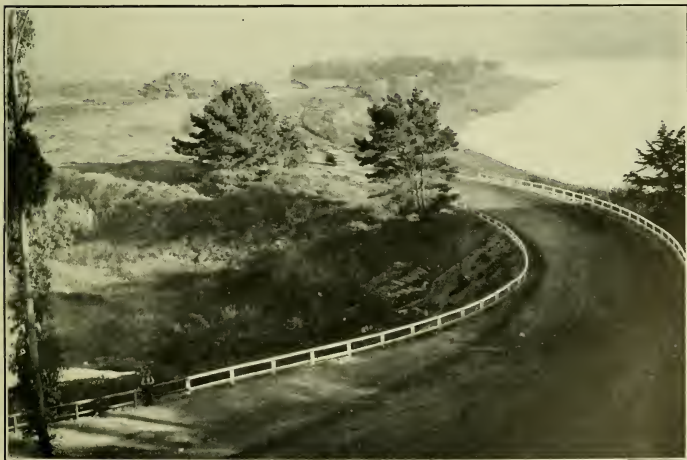
Marina Boulevard:

The section of the Marina Boulevard between Steiner Street and Lyon Street was paved during the year. The completion of this work and of the newly constructed drive through Lincoln Park allows of a continuous scenic roadway along the north bay shore of the City, past the Golden Gate, and along the ocean beach to the Skyline Boulevard.



HARDING GOLF LINKS ROAD

Scenic drive through Lake Merced lands of Spring Valley Water Company connecting Municipal Golf Links in Harding Park with Skyline Boulevard.

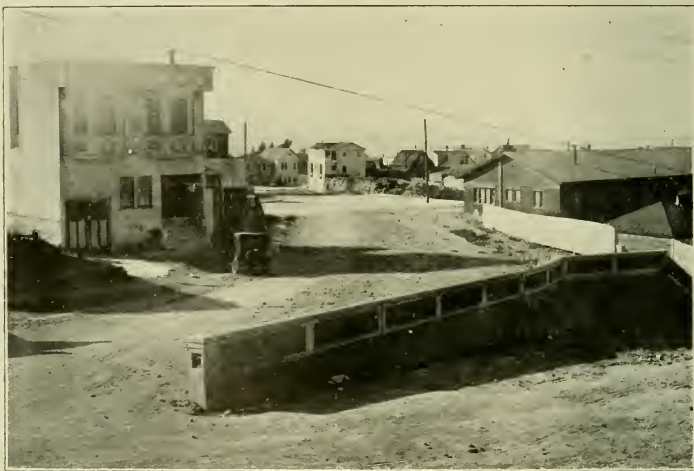


Harding Golf Links Road:

A road connecting the Harding Municipal Golf Links with the Sky-line Boulevard was constructed over a 50 foot easement given by the Spring Valley Water Company through their Lake Merced property. The roadway was macadamized for a width of 35 feet with 2½ foot shoulders, and approximately 2 acres of parking area for automobiles was graded and macadamized.

Southern Heights Avenue:

The grading and construction of retaining walls on Southern Heights Avenue has been completed. The City purchased the necessary lands for opening this low grade diagonal street which connects localities in the Potrero Hills section, previously reached only by traveling over



SOUTHERN HEIGHTS AVENUE

Low grade diagonal street in Potrero Hills section of City. View shows retaining wall and separation of roadways at intersection with Carolina Street.

heavy up-and-down grades. A contract for paving this street will soon be prepared.

Widening Streets:

With the increase in vehicular traffic during the past few years, the width of roadway on many of the most traveled streets of this City has proved insufficient. Other large cities throughout the United States have experienced the same handicap and in many instances the problem can be solved only by the purchase of land and reconstruction of buildings at an enormous cost to the cities and property owners. Fortunately, in the City of San Francisco the width of sidewalks on most of the



GEARY STREET EASTERLY FROM MASON STREET

Congestion of traffic (in background) due to street railway service and narrow roadway. Section in immediate foreground has been widened by a 3 foot reduction of both sidewalks, allowing ample space for vehicular traffic between tracks and parking area.

streets has been more than sufficient to care for the pedestrian traffic, thus allowing the roadways to be increased by cutting down the sidewalks. The roadway of Geary Street from Van Ness Avenue to Mason Street is now being widened 6 feet to a width of 44 feet 9 inches by reducing the sidewalks from 15 feet to 12 feet in width. The property owners are required to reconstruct all area walls, traps, etc., to the new lines, the setting back of curbs and paving being done under contract let by the City. The estimated cost of this work is \$22,000, towards which the City is paying \$20,000, the balance being paid by the property owners. In addition the property owners will pay for the installation of the street lighting system, which will be turned over to the City, thus dividing the cost of the total improvement about equally between the City and the property owners.

Kearny Street from Market Street to Columbus Avenue, a distance of 10 blocks, will be similarly widened as plans have been prepared for securing a roadway of 47 feet by narrowing the sidewalks from the present 18 foot width to 14 feet. Another such improvement is planned for Clement Street between Arguello Boulevard and Funston Avenue by reducing sidewalk widths 2 feet.

On Bush and Pine Streets, two of the heavily traveled streets, advantage has been taken of the reconstruction of these pavements in the downtown district by the Bureau of Street Repairs to widen the roadways by reduction of sidewalks.

San Jose Avenue from the County Line to Bernal Cut is being widened to a width of 80 feet as this is the southerly link in the proposed cross town Bernal Cut thoroughfare, embracing also Van Ness Avenue and Capp Street. It was necessary to acquire property for this widening as the existing street had a maximum width of 66 feet. Curbs were re-set and paving completed during the year on the section from Havelock Street to Cotter Street, this portion having been paved previous to the widening. Private contracts for improvement have been filed on other sections which have not been paved and upon completion of the bridge soon to be constructed across the Southern Pacific Railway tracks at Mount Vernon Avenue, San Jose Avenue will be paved to the County line.

Telegraph Hill Boulevard:

As soon as the ornamental balustrade and cement work being constructed about the parking area on Telegraph Hill under direction of the Park Commission is completed, bids will be taken on the paving of the boulevard. The scenic road was graded last year and plans and specifications for the paving have been prepared.

Market Street Extension:

Practically all the rights of way for the portion of the Market Street Extension remaining unpaved—from Ord Street to Clayton Street—have been purchased and it is expected that construction of this link will be started shortly when funds are available.



SILVER AVENUE

Pavement on cross-connecting thoroughfare between two main traveled routes—20 foot concrete central strip with asphaltic concrete pavement on both sides.

STREET WORK PERFORMED UNDER CONTRACTS

JULY 1, 1924—JUNE 30, 1925

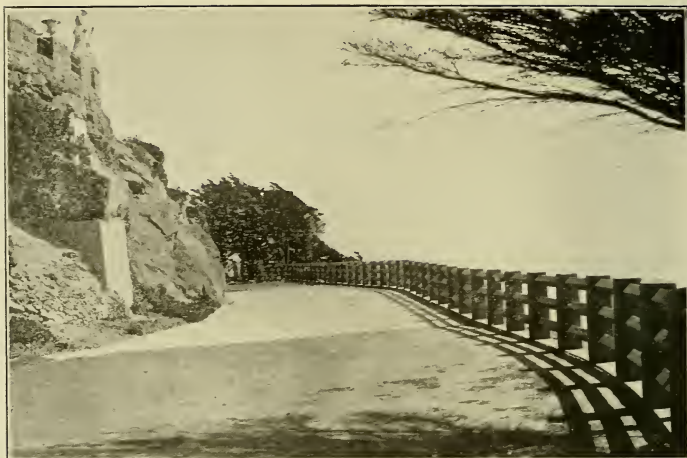
	Quantity	Cost
Asphaltic Concrete Pavement, 6" concrete base.		
Wearing surface 1½", paint coat	346,526 sq. yds.	\$876,187
Asphaltic Concrete Pavement, with vitrified brick strip, 6" concrete base.		
Wearing surface 1½", paint coat	2,940 sq. yds.	7,514
Vertical fibre brick	1,337 sq. yds.	7,765
Asphaltic Concrete Pavement, with concrete strip.		
Wearing surface 1½", paint coat, 6" concrete base	6,716 sq. yds.	18,068
Concrete Pavement, 6"	3,452 sq. yds.	9,265
Asphaltic Concrete Pavement, with basalt block strip, 6" concrete base.		
Wearing surface 1½", paint coat	868 sq. yds.	2,187
Basalt block, gravel and asphalt filler.....	433 sq. yds.	2,532
Asphalt Pavement, 6" concrete base.		
Wearing surface 2"	484 sq. yds.	1,651
Wearing surface 1", binder 1½"	15,647 sq. yds.	36,051
Asphalt Pavement, with vitrified brick strip, 6" concrete base.		
Wearing surface 2"	184 sq. yds.	579
Vertical fibre brick	134 sq. yds.	782
Asphalt Pavement, 3½" asphaltic concrete base.		
Wearing surface 1½"	243 sq. yds.	557
Asphalt Surface on binder—conform	128 sq. yds.	97
Concrete Pavement, 6".....	55,476 sq. yds.	143,837
Basalt Block Pavement—reset.....	173 sq. yds.	72
Broken Rock Pavement.....	14,783 cu. yds.	38,864
Gutters:		
Concrete	9,703 sq. yds.	29,282
Brick	292 sq. yds.	525
Curb:		
Granite (new).....	839 lin. ft.	2,182
Granite (reset).....	1,020 lin. ft.	765
Granite (redressed and reset).....	300 lin. ft.	300
Concrete, armored (new).....	180,029 lin. ft.	163,981
Concrete, armored (reset).....	2,010 lin. ft.	995
Coping, concrete.....	2,279 lin. ft.	2,689
Headers, redwood.....	805 lin. ft.	299
Sidewalks, artificial stone.....	40,755 sq. yds.	61,825

	Quantity	Cost
Grading:		
Cut	395,665 cu. yds.	\$337,909
Fill	8,519 cu. yds.	5,643
Walls, Stairways, etc.:		
Retaining Walls, concrete	756 cu. yds.	16,139
Stairways, concrete	3 flights	516
Balustrade, concrete	168 lin. ft.	1,341
Parapet Roadway, reinforced concrete, 8" slab, on beams and columns, etc.....	257 sq. yds.	5,735
Guard Fence.....	2,522 lin. ft.	2,162
Sewers—Ironstone Pipe:		
6" (side sewers)	16,686 lin. ft.	19,696
8"	25,952 lin. ft.	60,789
10"	188 lin. ft.	386
12"	13,691 lin. ft.	39,271
15"	4,599 lin. ft.	15,180
18"	2,831 lin. ft.	10,927
21"	1,354 lin. ft.	4,810
24"	41 lin. ft.	183
24" (in concrete).....	2,342 lin. ft.	19,740
Sewers—Cast Iron Pipe:		
6"	3,370 lin. ft. }	11,966
8"	2,364 lin. ft. }	
Sewers—Concrete:		
2'x3'	1,351 lin. ft.	11,145
2'-6"x3'-9"	531 lin. ft.	5,310
Taper Connection.....	1	200
Y—on I. S. P. Sewer:		
On 8" sewer.....	1,368	1,904
On 10" sewer.....	6	12
On 12" sewer.....	494	765
On 15" sewer.....	114	314
On 18" sewer.....	94	165
On 21" sewer.....	34	68
On 24" sewer.....	80	640
Manholes:		
On I. S. P. Sewers.....	261	29,825
On Concrete Sewers.....	9	900
Lampholes	4	65
Catchbasins:		
New	351	42,905
Reset	22	1,275
Stormwater Inlets:		
New	4	313
Reset	1	25

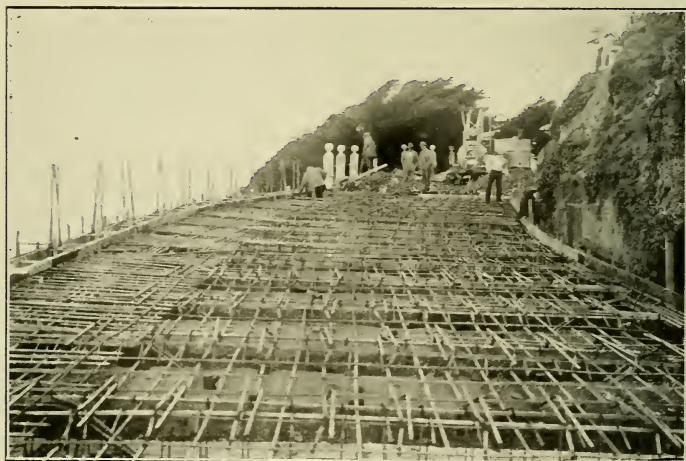
Culverts:	Quantity	Cost
10" Ironstone Pipe	10,970 lin. ft.	\$20,363
18" Ironstone Pipe.....	320 lin. ft.	686
24" Ironstone Pipe.....	206 lin. ft.	526
10" Corrugated Galv. Iron Pipe.....	82 lin. ft.	400
12" Corrugated Galv. Iron Pipe.....	327 lin. ft.	556
18" Corrugated Galv. Iron Pipe in concrete..	196 lin. ft.	1,011
12"x12" Redwood Box.....	551 lin. ft.	1,733
Subdrain—8" I. S. P. in crushed rock.....	410 lin. ft.	9,345
Traps	5	100
Miscellaneous—drainage, bulkheads, removing obstructions		2,538
Total Costs		<u>\$2,094,333</u>

Summary—Cost of Street Work:

Work under public contracts.....	\$ 441,340
Work under private contracts.....	1,295,527
Work under City pay contracts.....	357,466
Total	<u>\$2,094,333</u>



Reinforced concrete roadway slab and parapet wall in Sutro Heights Park replacing portion of roadway destroyed by slides.



View during construction showing reinforcement of slab and supporting beams and columns in place.

SUTRO HEIGHTS PARAPET ROADWAY

STRUCTURES AND MISCELLANEOUS CONSTRUCTION

Sutro Heights Parapet Roadway and Walls:

Due to heavy slides on the precipitous slopes of Sutro Heights overlooking Point Lobos Avenue, trimming of the slopes and construction of a rubble wall was thought necessary by Park Superintendent McLaren. This wall was approximately 190 feet in length and 15 feet in thickness at the base, tapering in at a height of 175 feet to 50 feet in length. The boulders forming the wall were interlocked and the interstices packed with clay. A heavily tamped fill of clay was put in back of the wall and the surface of the fill sealed with oil to prevent seepage of water back of the wall.



RUBBLE WALL AT SUTRO HEIGHTS

Protection of Point Lobos Avenue and prevention of slides from precipitous slopes of Sutro Heights afforded by wall of interlocked boulders with clay-packed interstices.

The slides also extended into the roadway encircling the Park near the Dr. Merritt residence on the summit of the Heights. To preserve the roadway a reinforced concrete roadway slab and parapet wall supported on heavy beams and columns was constructed on the west side over a length of 108 feet. The supporting beams and columns were anchored into solid rock on the hillside.

Traffic Gates and Signals—Islais Creek Bridge:

The vehicular traffic across the Third Street Bridge at Islais Creek has increased to such a point that automatic traffic gates and warning

signals are required to replace the obsolete hand-operated gates. A system of electrically operated gates, signals and lights designed in this department are now being installed under contract.

Street Signs:

The furnishing and erecting of 684 street signs was completed under contract. Of this number, 499 were type "A" signs and standards which were placed mostly in the downtown business and apartment districts and along the main traffic streets in the Western Addition and also in the Excelsior Homestead District. The other 185 signs, type "B", consisting of enamelled plates on redwood backs were placed on buildings and improvements on the smaller streets and alleys in the downtown district.

In the past four years, four contracts for furnishing and erecting street signs have been completed and a total of 1823 type "A" signs and standards and 273 type "B" signs erected. Bids will be received for 589 additional signs under Contract 5 as soon as the funds are made available, the sum of \$10,000 being predicated for new street signs and repairs and replacements in the budget for the ensuing fiscal year.

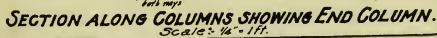
San Jose Avenue Bridge:

A structure has been designed to replace the old steel trestle built about 1890 on San Jose Avenue at Mount Vernon Avenue to carry the tracks of the first electric railway in San Francisco over the Southern Pacific Railroad. The new bridge will be of reinforced concrete and structural steel, 600 feet in length, including approaches, with a clear roadway width of 60 feet and two 10-foot sidewalks, and will also carry a double line of street railway tracks. Future double tracking of the Southern Pacific Railroad lines is provided for by two clear spans of 17 feet. Center supports are necessary as the actual width of crossing is 103 feet due to the fact that the railroad crosses San Jose Avenue on a skew at about a 19 degree angle. The combination of the skew and of the grade on the approach introduces intricate problems of design and construction, and also increases the estimated cost of the structure above that of one with a right angle crossing. Much of the credit for the design of this bridge is due to Assistant Engineers W. H. Ohmen and J. O. Hanson.

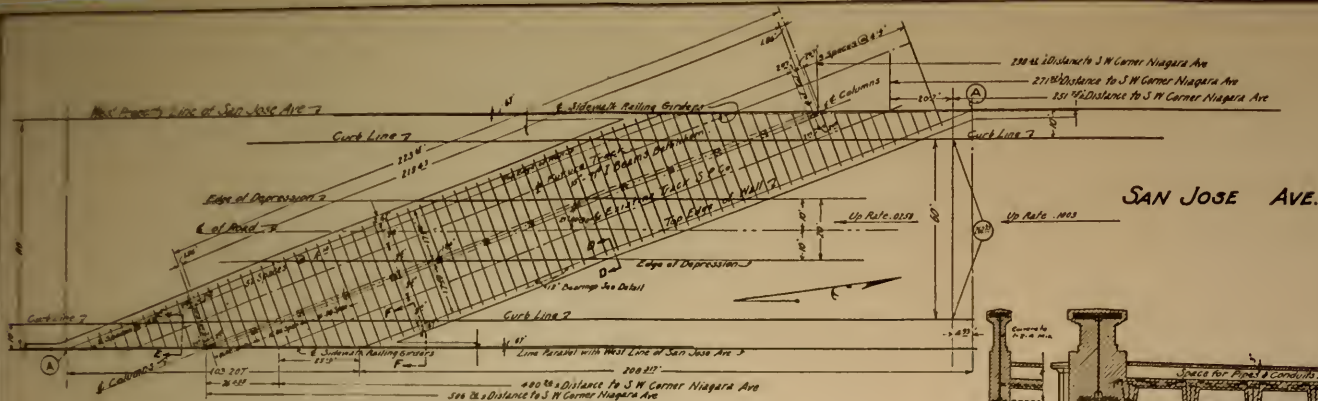
Massive concrete gravity walls will retain the fills on the approaches and form the buttress walls supporting the steel superstructure of the span. At the acute angled junctions of the buttress and approach walls, the cellular type of reinforced concrete walls was adopted to reduce the mass of concrete necessary. The height of wall necessary will range up to 34 feet from foundation to street grade.

In order to keep the maximum grade of approach on San Jose Avenue less than 10% and obtain a required overhead clearance of 22 feet above the railroad, it will be necessary to lower the railroad tracks, under the span, 5 feet and reconstruct 1600 feet of track.

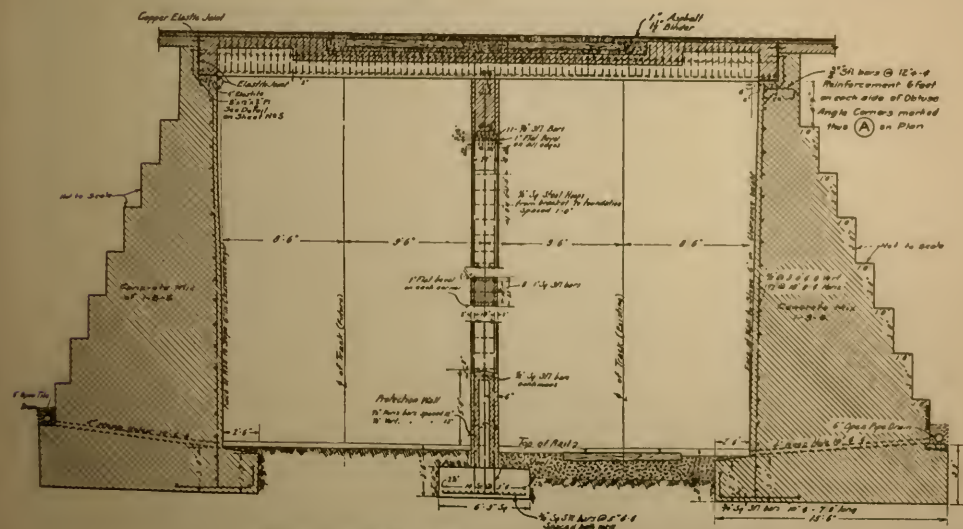
JOSE AVE.



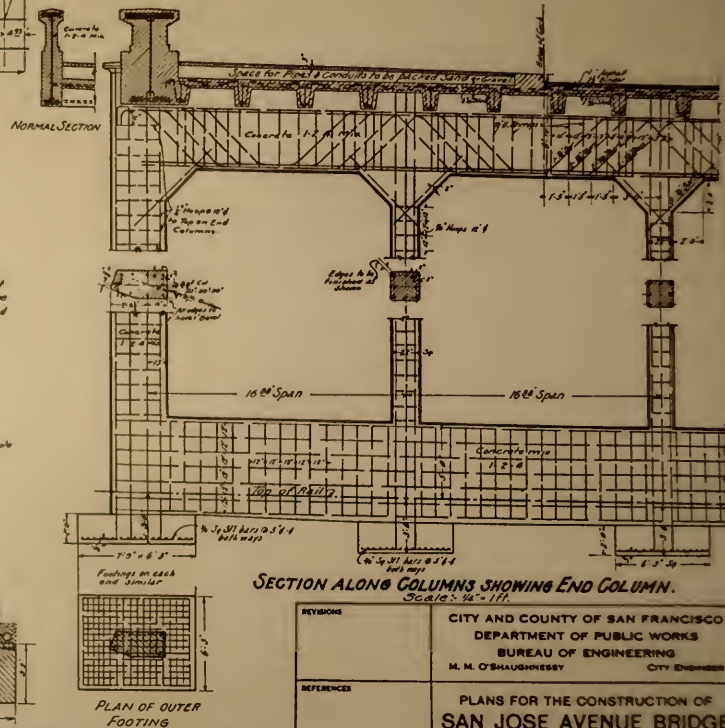
REVISIONS	CITY AND COUNTY OF SAN FRANCISCO DEPARTMENT OF PUBLIC WORKS BUREAU OF ENGINEERING M. M. O'SHAUGHNESSY CITY ENGINEER		
REFERENCES	PLANS FOR THE CONSTRUCTION OF SAN JOSE AVENUE BRIDGE AT MOUNT VERNON AVENUE.		
	SCALE AS SHOWN	IN 11 SHEET	SHEET NO. 4.
DRAWN BY CHECKED BY J.C.M. J.C.G. A.E.E. Y.M.D.	APPROVED <i>William O'Shaughnessy</i> July 2, 1923		DATE FILE A-6532



DIAGRAMMATIC PLAN OF BRIDGE OVER S. P. CO. RY.
Scale 1" = 20'
For Sections D-D, E-E, F-F, see Sheet NTS.

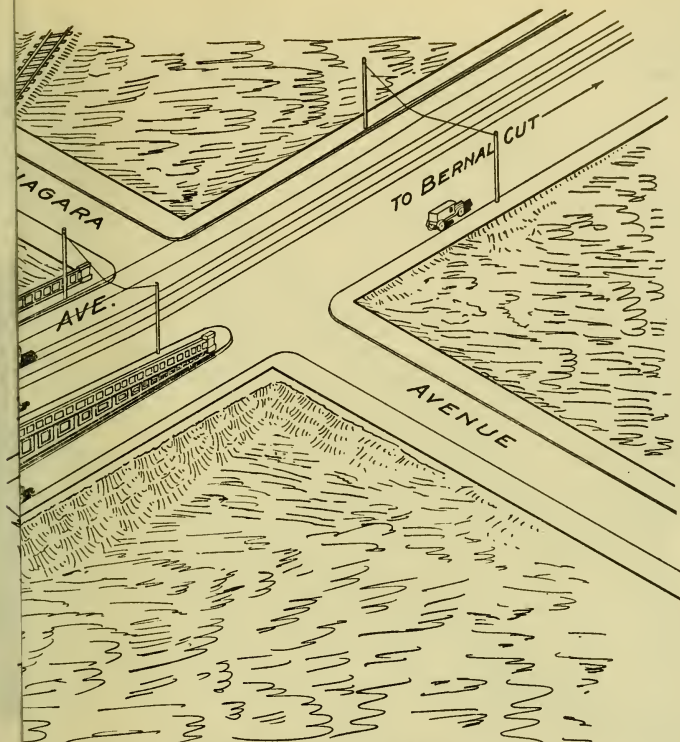


SECTION OF BRIDGE AT CENTER OF SAN JOSE AVE.
Scale $\frac{1}{4}'' = 1 ft.$



SECTION ALONG COLUMNS SHOWING END COLUMN.
Scale: $\frac{1}{4}" = 1 \text{ ft.}$

REVISIONS	CITY AND COUNTY OF SAN FRANCISCO DEPARTMENT OF PUBLIC WORKS BUREAU OF ENGINEERING M. M. O'SHAUGHNESSY CITY ENGINEER		
REFERENCES	PLANS FOR THE CONSTRUCTION OF SAN JOSE AVENUE BRIDGE AT MOUNT VERNON AVENUE		
	SCALE	AS SHOWN IN 11 SHEET	
DRAWN BY J. C. H. CHECKED BY A. E. H. MDU	APPROVED <i>William C. Higgins</i> MAY 22 1903	DATE	FILE A 6532



SAN JOSE AVENUE BRIDGE

CROSSING

SOUTHERN PACIFIC TRACKS

AT

MOUNT VERNON AVENUE

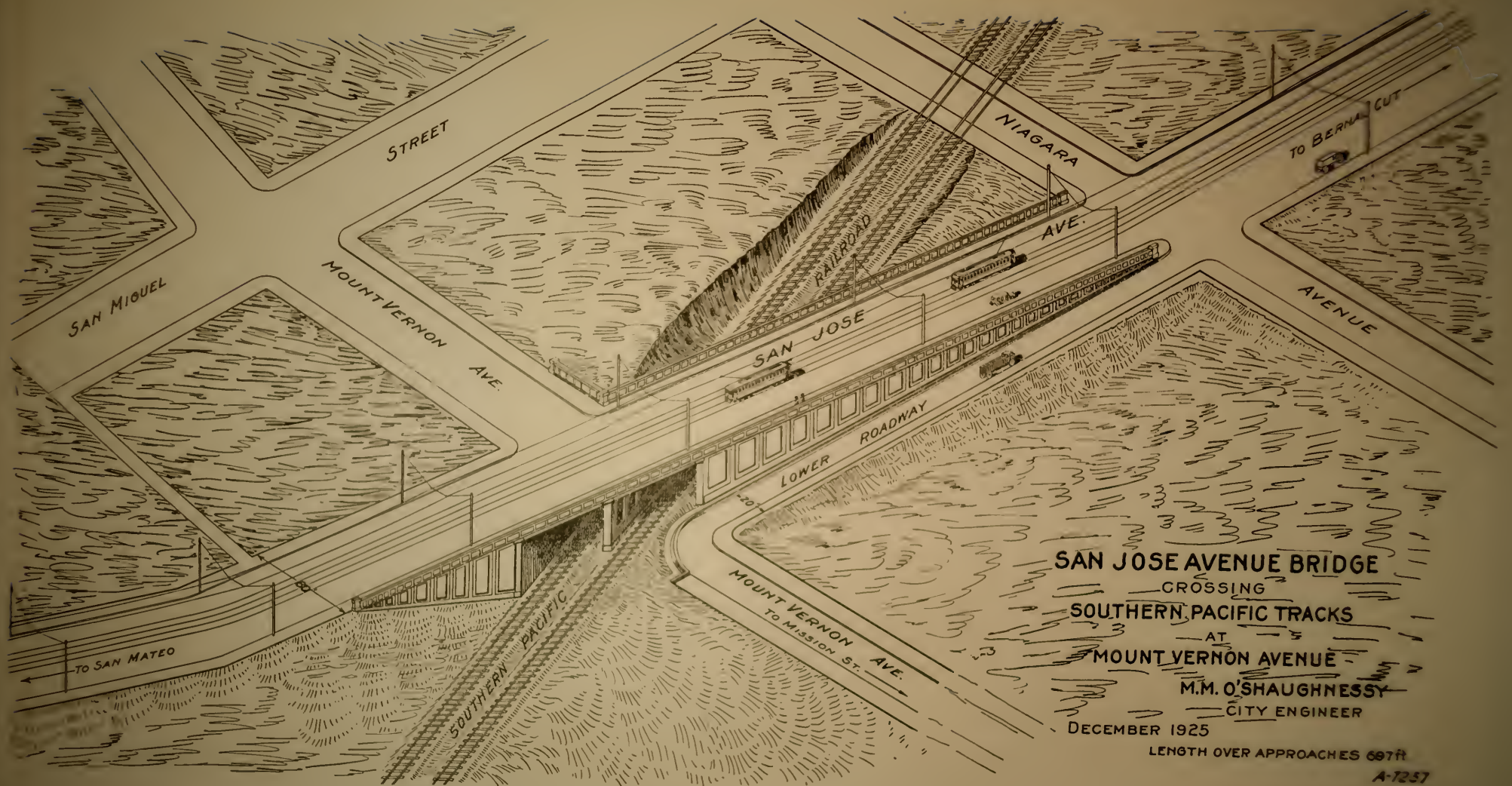
M.M. O'SHAUGHNESSY

CITY ENGINEER

DECEMBER 1925

LENGTH OVER APPROACHES 697ft.

A-7257



SAN JOSE AVENUE BRIDGE
— CROSSING —
SOUTHERN PACIFIC TRACKS
— AT —
MOUNT VERNON AVENUE
M.M. O'SHAUGHNESSY
— CITY ENGINEER —

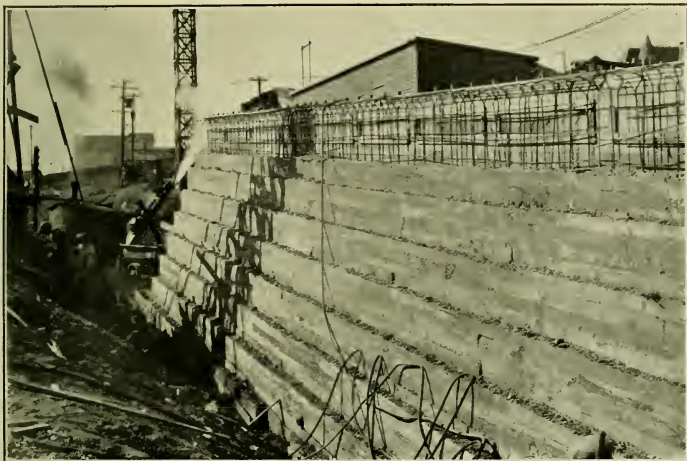
DECEMBER 1925

LENGTH OVER APPROACHES 697ft

A-7257

Mount Vernon Avenue, which intersects San Jose Avenue at the railroad crossing from the west will be brought up to the level of and connect with the roadway on the structure. A lower roadway parallel and adjacent to the north approach wall will connect Mount Vernon Avenue on the easterly side to Niagara Avenue at one end of the structure.

The estimated cost of the total improvement is \$150,000, of which sum the Market Street Railway will pay \$25,000, partly in cash and the



SAN JOSE AVENUE BRIDGE AT MOUNT VERNON AVENUE.

View showing stepping of massive concrete gravity walls to retain fills on approaches to steel and concrete structure over railway tracks.

balance expended in reconstruction of their track over the bridge and approaches. The company also relinquishes all right and title in the structure upon the expiration of their franchise over this street, although their equity in the old bridge must be included in evaluation of their properties if purchased by the City.

This improvement is of great importance in the highway development of the City as San Jose Avenue to the north connects with the proposed Bernal Cut and Capp Street improvements, and to the south with the Peninsula highway and also intersecting the proposed Alemany Boulevard over the old Ocean Shore Railway right of way.

Evans Avenue Bridge at Army Street:

The sum of \$10,000 has been placed in this year's budget for the construction of a viaduct on Evans Avenue over the railway cut to con-

nect this avenue with Army Street. A temporary wooden structure has been designed for this location as a permanent concrete viaduct would cost approximately \$40,000.

The development of the territory adjacent to Evans Avenue for industrial sites, as planned under a proposed reclamation act, will be forwarded by putting through this thoroughfare to Army Street. Therefore the construction of the bridge and also the grading of Army Street will be undertaken during the coming year.

High Pressure System Extensions:

Layouts and estimates were prepared for various extensions of the auxiliary water supply (high pressure) system for fire protection—the more important extensions planned being from Fifteenth and Kansas Streets to Sixteenth and Carolina Streets, and on Beach and North Point Streets between Jones and Powell Streets. A report was made on the condition and repairs necessary to the older fire cisterns. The total estimate of the high pressure system extensions and repairs recommended is \$67,000.

Tuberculosis Preventorium:

Preliminary development work on the land purchased for the Tuberculosis Preventorium, a project of the San Francisco Department of Public Health, is in progress under the direction of the City Engineer.

The Preventorium is to be located on a 301.6 acre tract owned by the City, near the Pulgas Tunnel of the Hetch Hetchy Aqueduct, about $3\frac{1}{2}$ miles west of Redwood City in the hills east of the Crystal Springs Reservoir of the Spring Valley Water Company. The area is well wooded and the location particularly favored as to climate. There is but little wind and practically no fog, excepting for a very few days in the winter season. The principal group of hospital buildings is to be located on an elevated area commanding a view of the San Francisco Bay region.

About 100 acres have been cleared of brush and undergrowth and the area surveyed and mapped. The main road to the building site has been surveyed and is now under construction. The road, 32 feet in width and $2\frac{1}{2}$ miles long, leaves the County Road from Redwood City, runs through the property past the building site, then over the ridge and connects to the Crystal Springs-Woodside Road, thus making the site accessible from both the State Highway and the Skyline Boulevard. Specifications for the construction of the road were prepared in this office and after bids received Wednesday, May 20th, the contract was awarded to Farrar and Carlin in the estimated sum of \$46,973. 2500 feet of 4-foot concrete culvert pipe will be installed under the road contract to carry the water of Laurel Creek and will make the canyon area available for recreational grounds or for buildings by permitting the filling of the original creek channel, which is wide, deep and winding. After investigation of pipe manufactured by the various dealers, it was decided in the interests of economy to make the pipe on the job. This work is now being carried on by a force of nine men. Equipment con-



LAUREL CREEK CULVERT, TUBERCULAR PREVENTORIUM SITE

Concrete pipe, manufactured by City employees, to be laid in the channel at the left, part of which is the old creek channel and part an excavated trench.

sists of a small portable concrete mixer and 20 collapsible wooden pipe forms. The pipe is 48 inches internal diameter, $4\frac{1}{2}$ inches in thickness and is built in 3 foot lengths. The pipe joints are male and female 2 inches deep, which when laid and mortared give a smooth joint. The reinforcement consists of $\frac{5}{16}$ inch plain steel bars in rings 6 inches center to center, with no longitudinal steel. The concrete mixture consists of one volume cement to $1\frac{3}{4}$ of sand and $3\frac{1}{4}$ of gravel to pass a $\frac{3}{4}$ inch mesh.

The total cost of the preliminary construction work now under way will be about \$70,000. M. J. Bartell as construction engineer has charge of the work in the field.

SEWERS

Great Highway Sewer Extension from Ortega Street to Rivera Street:

The reinforced concrete sewer in Great Highway previously constructed to Ortega Street has been extended to Rivera Street, 1351 lineal feet of 2 foot by 3 foot sewer and 531 lineal feet of 2 feet 6 inch by 3 foot 9 inch having been constructed. Under the same contract, 363 lineal feet of 21 inch ironstone pipe sewer were laid in the intersecting streets, connecting sewers in Forty-Eighth Avenue between Ortega and Rivera Streets with the Great Highway outlet sewer.

Harding Municipal Golf Links Outlet Sewer:

Five thousand seven hundred and thirty-four lineal feet of 6 inch and 8 inch sewer were laid as an outlet from the municipal golf links, established on lands at Lake Merced recently leased from Spring Valley Water Company. In order to protect the watershed from any possible contamination, cast iron pipe, from the Auxiliary High Pressure Water System, with lead joints, was used in this construction. This outlet was constructed to a point clear of the watershed and will eventually lead into the Mile Rock outlet system.

Sunset Central District Sewer:

Construction is under way on a section of the sewer tapping the central portion of the Sunset District. Over 3220 feet of concrete sewer, mainly 3 ft. by 4 ft. 6 inch in size will be built under this contract on Thirtieth Avenue from Lincoln Way to Kirkham Street and on Kirkham Street between Thirtieth and Twenty-sixth Avenues.

The development of this district has been so rapid that since the contract for this section of sewer has been let a further extension of the sewer along Kirkham Street to Twenty-third Avenue, thence to Lawton Street, has been deemed expedient. Plans are now being prepared and bids will soon be asked for on this extension.

Great Highway and Vicente Street Outfall Sewer System:

The elevation of the area bordering on the Great Highway between Santiago Street and Sloat Boulevard is such that the district cannot be served by a gravity system of sewers which would discharge into the main sewer leading to one of the selected points of outfall. It was therefore necessary to design a separate system, wherein the storm flow would outlet locally and the sanitary flow be pumped into the main or outfall sewerage system.

Construction has been started under a contract which includes an underground tank, 17 ft. 6 inch by 75 ft., a pump house, 1632 feet of 21 inch and 24 inch ironstone pipe storm sewer and 1210 feet of 10 inch cast iron discharge line. The pumping units will consist of two 6-inch automatically operated pumps driven by electric motors and will be installed under a future contract upon completion of the tank and pump house. The necessary sanitary sewers connecting with the tank are being constructed under private contracts and are being paid for by

the owners of property directly fronting thereon. The Park Commissioners were extremely vigilant in protecting the beach near the swimming pool intake in this vicinity from pollution.

Marina District Sewers:

The outlet sewers in the Marina District (the former Panama Pacific Exposition site) were provided by cooperation of the property owners and the City in the construction of 2342 lineal feet of 24 inch iron-stone pipe sewer encased in concrete, at a total cost of \$23,058. Of this amount the City paid \$7026, representing the cost of the concrete cover, the property fronting directly on the sewers paid at the rate of \$1.50 per front foot, amounting to \$5594; the balance, \$10,438, was distributed over the drainage district contributory to the system.

This method of distributing the cost of local outlet sewers between the frontage and the drainage district served is eminently fair and is practical in application, especially where the property is in large holdings, thus giving fewer owners to deal with.

Proposed Sewers:

In requesting that the sum of \$1,747,000 for construction of sewers be included in the budget for 1925-26, this Department wrote as follows:

"The rapid growth of the City is also reflected in the increased appropriations requested for street work and for extensions to the sewerage system. I cannot emphasize too strongly the necessity of constructing the outlet sewers as listed. Due to the insufficient appropriations made in former years—appropriations which were ridiculously small in view of the work to be done—the City has fallen behind and is acting as a drag to the building progress of the property owners. Residential tract development and construction demand sewers and pavements, and without main sewer outlets, local sewers are useless. Each year brings a demand for further extensions—postponement of construction due to lack of funds has placed us in the position of requiring immediately almost \$1,750,000 for sewer construction.

College Hill Tunnel Sewer.....\$300,000

To carry to the North Point main sewer the sewage of the Crocker Amazon, Excelsior, Homestead, College Homestead, Glen Park, and other districts comprising the entire upper Islais Creek district of 5 square miles in area, now emptying into Islais Creek below the Mission Street Viaduct.

Fillmore Street and McAllister Street Sewers..... 650,000

To relieve the present overloaded McAllister Street sewer and prevent recurrence of the frequent flooding during storms of stores on Fillmore Street from Sutter Street southerly.

Sunset Central District Sewer..... 115,000

To complete the construction of this main sewer draining the central part of the Sunset District, a portion of which is to be built from funds provided in this year's budget.

Sunset Westerly District Sewer..... 400,000

To allow paving and improvements of Santiago Street in the Parkside District and the area northerly therefrom—the sewerage of which requires the construction of almost 3 miles of concrete sewers to reach the existing sewer in Lincoln Way.

Visitation Valley (Sunnydale Avenue) Sewer Extension..... 25,000

To provide outlet sewer for the Sunnydale District of Visitation Valley—the improvement of which is rightfully demanded by the property owners.

Sixth Street Sewer, from Townsend Street to the Channel..... 75,000

To replace the old brick sewer constructed in 1876, now inadequate and in bad condition, a construction necessary previous to the reconstruction of the street.

Third Street Sewer..... 100,000

To remedy sanitary conditions and provide sewer outlet for industries in the Potrero tract adjacent to Third Street near Islais Creek.

Ingleside Sewer Extension..... 6,000

To extend Ingleside sewer across Junipero Serra Boulevard and provide an overflow for storm waters, correcting a nuisance existing during storm runoffs.

Guttenberg Sewer Extension..... 11,000

To allow paving and sewerage of adjacent districts.

Canal Street Sewer Extension—City's portion..... 15,000

To carry outlet of present sewer below tracts now being developed or proposed, thus providing sewer outlet for same and improving sanitary conditions; the balance of the cost to be borne by the tracts benefitted.

Miscellaneous Sewer Extensions..... 50,000

To provide for minor sewer construction as demanded by tract development and to meet assessments on City property where sewers are constructed under public or private contracts."

In spite of this urgent request, the Board of Supervisors saw fit to allow but \$300,000 for main sewer extensions and later even reduced the available amount to \$200,000. Immediate construction of the Ingleside sewer extension and sections of the Sunset Central District and the Sunset Westerly District sewers, as far as consistent with the monies available, will be recommended.

Side Sewers:

During the past year, 2772 applications for side sewer installations, with deposits totaling \$213,425 were received, many applications covering two or more side sewers. This is an increase of 113 in applications and \$13,592 in deposits over the previous fiscal year.

A study of the cost of constructing side sewers in the City has been made and a schedule of prices per lineal foot by districts has been established. These prices include the cost of pipe and cement which will be supplied by the City instead of by the property owners as heretofore.

This schedule will be in effect after July 1, 1925, and will eliminate the payment of refunds and the necessary bookkeeping in conjunction with same. This system will not only save the property owner time and money in procuring materials and in collecting refunds but will also simplify to a great extent the bookkeeping and records of this and other departments handling the side sewer records and deposits.

Deposits Received for Side Sewers

Date	No. of Applications	Amount
1924		
July	228	\$17,475
August	216	15,109
September	257	19,455
October	278	20,615
November	190	15,317
December	235	17,210
1925		
January	209	15,034
February	179	13,972
March	257	20,424
April	252	19,987
May	223	19,140
June	248	19,687
Total	2772	\$213,425

Drainage Maps and Investigations:

Examinations of the waters along the northerly beaches of the City and studies of the permanent sewage disposal along the bay shore are being made in order to ascertain and eliminate causes of unsanitary conditions on the beaches, according to complaints received by State Board of Health.

The Islais Creek Valley between San Bruno Avenue and Mission Street has been surveyed and contours plotted as a preliminary to a study of the necessary drainage structures to properly serve this district.

Work on complete detailed drainage maps of the City has been continued. The utility of these maps has been manifested during the past year when the demand for information on sewers was very heavy. These demands have been met without loss of time where the desired information has been plotted on the drainage maps.

STREET IMPROVEMENT ASSESSMENTS, ETC.

Assessments and Bonds for Street Work

Assessments issued for cost of street work performed.....	71
Cost of street improvements covered by assessments.....	\$617,686.59
Bonds prepared (in triplicate).....	231
Amount of assessments guaranteed by bonds.....	\$ 70,898.57
Average amount guaranteed by each bond.....	\$ 306.92

Street Work Proceedings

Resolutions of Intention passed.....	75
Street improvements recommended under Resolution of Intention	97
Notices of street improvement posted.....	1687
Notices of Resolutions of Intention mailed.....	4595
Ordinances ordering performance of street improvements passed	92
Proposals of street improvements published.....	110
Public contracts for street improvements awarded.....	88
Private contracts filed.....	373

Notices, Permits and Investigations

Notice to construct and repair sidewalks.....	1915
Notice to construct bulkheads.....	611
Notice to remove obstructions.....	516
Notice to construct guard rails.....	16
Notice to reconstruct side sewers.....	353
Street space permits reported on.....	4311
House moving permits reported on.....	112
Miscellaneous calls and investigations.....	3120

Permits and Fees for Corporation Trenches, etc.

(In conformity with Ordinance 2201)

	Service Connections and Repairs	Mains Installed Lineal Feet	Fees Charged
Pacific Gas and Electric Co.....	7,666	110,590	\$12,370.50
Spring Valley Water Co.....	4,568	4,679	6,897.00
Pacific Telephone and Telegraph Co.....	473	52,618	1,147.50
Great Western Power Co.....	101	4,408	190.50
Western Union Telegraph Co.....	12	840	25.50
*Miscellaneous under Special Deposits.....			6,261.50
Total	12,820	173,135	\$26,892.50

*Permits granted for which special deposits were made to move steam shovels and tractors, to repair or install oil tanks, service pipes, fire alarm wires, cables and conduits, to lower curbs, etc.

SURVEYS

Surveys Performed

Made for	Number
Public Contracts.....	117
Private	397
Resurveys for Contracts (lost points).....	66
Municipal Departments.....	299
<hr/>	
Total for Public Improvements, etc.....	879
Lot Surveys—Private Owners.....	79
Municipal Departments.....	17
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Total Lot Surveys.....	96
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Total Surveys.....	975

Surveys include approximately 2227 blocks and crossings, a total length of 652,000 feet or 124 miles, in addition to 23 miles of monument lines, highway work and the replacing and covering of 116 monuments.

Precise Levels and Bench Marks

District	No. of Bench Marks
50 Vara.....	132
100 Vara.....	532
Excelsior Home Tract.....	380
Visitation Valley.....	201
University Mound Tract.....	407
Potrero and South San Francisco.....	102
Bernal Heights.....	342
Richmond	227
Sunset	516
Lakeview	148
Other Districts.....	208
<hr/>	
Total Bench Marks.....	3195
Precise Levels—Total Miles.....	101.2

Maps Approved and Filed with Recorder

Sunnyside, Block 33—Resubdivision.
 Fillmore Street—Widening.
 Mallorca Way—Realignment.
 Toledo Way and Cervantes Boulevard—Closing.
 Tunnel Avenue—Opening.
 St. Francis Wood Ext. No. 3.
 Southern Heights Avenue—Opening.
 Marina Court Tract, Block 466 A.
 Toledo Way—Realignment.
 Pierce Street—Widening.

Fifteenth Avenue—Widening.
 Balboa Terrace—Addition.
 Merritt Terrace—Addition.
 Roosevelt Way.
 Ortega Street—Widening.
 Islais Creek District—Realignment of streets.
 Randolph Street, Worcester and Orizaba Avenues—Widening.
 Monterey Heights.
 Colonial Park.

Fees Received for Surveys and Inspection

1924	Surveys	Inspection
July	\$ 761.50	\$ 1,743.75
August	1,026.00	2,639.50
September	1,042.60	563.25
October	1,193.00	1,888.50
November	911.00	1,628.80
December	1,223.75	1,512.00
1925		
January	932.25	1,983.00
February	1,213.60	786.25
March	2,160.25	2,544.75
April	1,813.25	2,845.10
May	2,477.50	2,022.75
June	1,494.40	1,302.00
	<hr/>	<hr/>
	\$16,249.10	\$21,459.65

MUNICIPAL RAILWAY

Market Street Railway Purchase:

The question of the purchase of the properties of the Market Street Railway Company, the first, and an essential step in the solution of San Francisco's transportation problem, is still unsettled. Previous reports have touched upon the intimate connection between this problem and the welfare of the City's street railway systems, and it is obvious that the question has a most important bearing not only on future development but also on the maintenance of the present facilities. The Market Street Railway Company is rendering good service with its present track and equipment which as a whole is maintained in fair operating condition in spite of the uncertain condition of the company's franchises, but, obviously, extensions to the system cannot be expected under present conditions. Meanwhile the city is rapidly outgrowing its transportation facilities and the time is approaching when some action will be forced upon us.

In spite of the development of the motor bus as a means of passenger transportation, and the inroads of the private automobile on street railway revenue, the further development of the street railway system is a very live issue in all of our large cities. Some large eastern cities are now experiencing the bitter results of haphazard and unplanned development. Many important cities are spending large sums in transportation studies, and everywhere, where two or more independent systems are in operation, the desirability of coordination or combination of the transit system is recognized and efforts are being made to bring about some agreement.

These considerations apply in a special degree to the City of San Francisco and justify the most careful study of our street railway problem. The development of the street railways of this city or any other city should be in conformity with a well considered, comprehensive plan, based on a study of the problem in its entirety. Here, advancement directed by any such planning is impossible without the settlement of the Market Street Railway purchase.

Financial studies show that the Market Street System cannot be taken over and be paid for out of earnings, as has been suggested, and maintain the present five cent fare with universal transfers. Following an investigation of eastern street railway operations, the St. Louis Board of Aldermen recently rendered a report which shows the rates of fare and transfer rules to be as follows:

Rates of Fare

	Street Railways			Buses	Transfers
	Cash ¢	Tickets ¢	Average ¢		
Pittsburgh	10	3 for 25	9.16 (a)	—	Free (b)
Baltimore	8	2 for 15	7.75 (a)	10 and 25	Free (c)
Washington	8	6 for 40	7.33 (a)	10 and 25	Some free (d)
Philadelphia	8	2 for 15	7.75 (a)	10	Some free (e)
New York	5 (f)	—	—	10 (5th Ave.) 5 (local)	None between companies (g)
Boston	10 (h)	—	9.25	—	Free
Montreal	7	4 for 25	6.5	10 (3 for 25)	
Cleveland	6		6.5	10	1¢ each (i)
Detroit	6		6.5	10	1¢ each (j)
Chicago	8, 7 (k)			10	

(a) Estimated, on the assumption that 50% of the fares are cash, and 50% are tickets.

(b) 2 fares for ride across City.

(c) No transfer from bus to railway.

(d) Charges vary, up to full fare for second ride.

(e) At 50% of railway intersections, and from bus to railway, 3c is charged.

(f) The 5c fare has not yielded sufficient revenue to pay interest and retirement charges on the City owned subways as required by the contracts between the operating companies and the City. The companies are about 80 million dollars in arrears, and these interest and bond retirement charges are paid out of tax funds. The equivalent cost of a ride is therefore 5c from the rider, plus a contribution from the taxpayer.

(g) Total cost of ride is often 10, 15 and 20 cents.

(h) Some 6c fares on short rides.

(i) Joint car and bus feeder ride, 10c.

(j) 10c combined ride on railways and City busses.

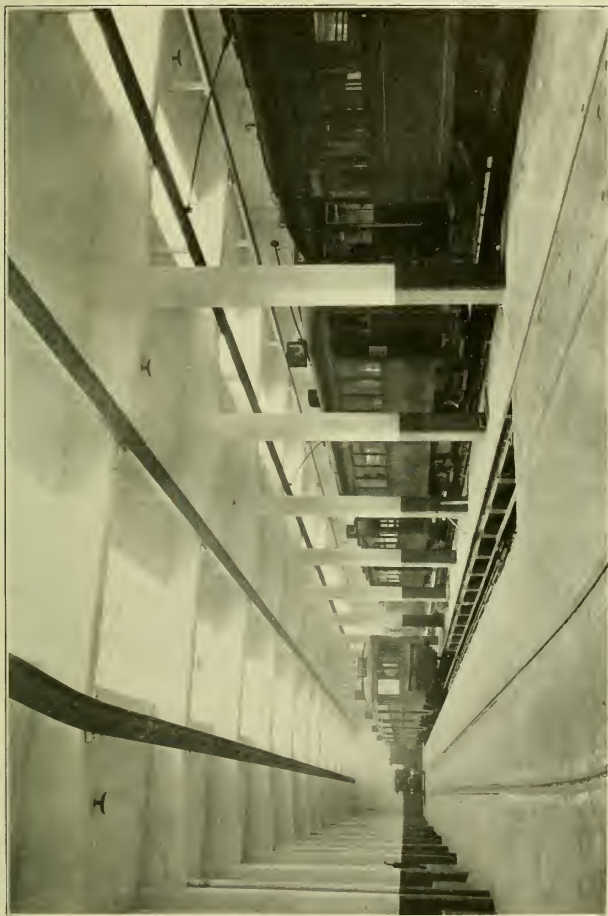
(k) 8c elevated; 7c surface.

From this it will be seen that New York is the only one of the ten cities listed where the 5 cent fare is still retained, and there a contribution toward transit subways of \$61,000,000 and annual receipt from taxes is necessary to meet interest and bond charges.

It seems not improbable that the immense congestion due to motor traffic and the inefficient use of valuable street space by parking is leading to a reaction that will be much to the advantage of the street railway.

Car Barns and Shops:

During the past year a second story was added to the Seventeenth Street car house in the Potrero. This addition does not cover the entire area of the lower story but provides, along the Hampshire Street side, four car storage tracks, equipped with inspection pits, and with a capacity of 22 cars. These tracks are connected with the Potrero Avenue line by a new track laid in Seventeenth Street. On the Mariposa Street frontage of the addition, offices for the assistant superintendent, dispatcher, in-



SEVENTEENTH STREET (POTERO) CARBARN, MUNICIPAL RAILWAY.
Interior of new second-story addition showing car storage space and repair pits.

spectors and cashier, and a waiting room, recreation room, reading room and ample locker space for the platform men are provided.

All of the shop and maintenance work of the Municipal Railway is still being done in the original space provided for the maintenance of the Geary Street line, which was adequate for a small system. The question of proper space and facilities for taking care of the enlarged railway property is becoming very acute. The railway management is already badly handicapped and should not be required longer than is necessary to operate without an adequate shop and maintenance yard.

There has already been acquired the southern half of the block immediately west of the Potrero car barn and bounded by Mariposa, York, Seventeenth and Bryant Street, and negotiations are under way for the purchase of the remaining portion of the block. York Street, which lies between the car barn and this block, will be closed, giving the railway two blocks and the dividing street. This additional area will give space for a repair shop, store room and maintenance of way yard. In addition to modern shops the proposed site will include a storage yard for the railway materials now kept at the Municipal Pipe Yard, resulting in greater efficiency in handling and taking care of these materials. The portion of the present car house not covered by the second story described above, will furnish an ideal site for a modern car painting shop and automobile bus garage. Switching service to the shop location is provided by the Southern Pacific Company, who have operating rights over the track of the defunct Ocean Shore Railway in Mariposa Street as far as York Street. Several requests have been made on the Board of Supervisors for funds to execute the consummation of the program outlined.

Equipment:

Additional cars are badly needed and on February 11, 1925, this department recommended that the Board of Public Works request authorization from the Supervisors for the purchase of not less than fifteen new cars. As yet no action has been taken on this request and now it is not only impossible to make additions to service but difficulty is being experienced in getting cars out of service long enough to make repairs and repaint them.

Extensions:

Requests are constantly being received for extensions of the Municipal Railway into various sections of the City. The obstacles mentioned in previous reports, namely lack of funds and the unsettled condition of the Market Street Railway purchase, still prevent the execution of any comprehensive plan of extensions to the Municipal Railway system. However, certain extensions have to be made in order to take care of some districts now without transportation and where there has been a very great increase in population in the past few years. The only means of making additions to the railway under present conditions is through the issuance of bonds. After informal discussion with members of the Board of Supervisors that Board called for a report embodying recommendations of this

department on Municipal Railway additions and betterments requiring or warranting early action.

This report, which follows, was submitted on February 26, 1925, but up to this time no action has been taken on the four recommendations included in the report.

February 26, 1925

To the Honorable
The Board of Supervisors of the
City and County of San Francisco.

Attention: Finance and Public Utilities Committees
Gentlemen:

In reply to the request contained in your letter of January 24, 1925, Resolution No. 22,789 (New Series) and your verbal requests for complete report dealing with matters relating to the Municipal Railway in general, I respectfully submit the following report which is divided into five parts, namely.

Recent Improvements.

New Projects.

San Mateo County Extension.

Bus Operation.

Depreciation Reserve.

In that division of the report dealing with New Projects, there is set forth all of the new projects which I believe to be worthy of consideration for construction in the near future. This section is subdivided into two parts: (1) Immediate Necessities. This covers those projects which should be undertaken at once from available funds regardless of whether a bond issue is carried or not. These are of primary importance and necessary to take care of the equipment we are now operating; to provide necessary additional cars and equipment for increasing service on existing lines; to extend service in a rapidly growing district entirely dependent upon the Municipal Railway; and to insure service and reduce the cost of rendering this service. (2) New Car Lines. This deals with new lines which I believe to be desirable and necessary but which cannot be financed from funds now on hand, and for which it will be necessary to issue bonds.

Recent Improvements

Preliminary to a discussion of proposed extensions I desire to call your attention to recent railway construction:

Ocean View Line: The grading for the extension of the railway into the Ocean View District, running from St. Francis Circle through the Spring Valley Company's Merced Rancho lands, was completed about a year ago. It was necessary to make two large earth fills across gulches which, on account of the dryness of the season, were likely to settle making it inadvisable to lay track at once. The settlement during the present wet season has shown the wisdom of this delay. The trolley poles, trolley wires and feeder cables have already been erected and contracts are about

to be awarded for the track laying which will be finished during the summer.

Simultaneously with this work, street improvements are taking place in Ocean View, and one of the great problems confronting the City is the revision of the rectangular streets in the City Land Association with the unanimous consent of the land owners, north of the railway and east of Junipero Serra Boulevard. Ninety-five per cent of the owners are perfectly willing to have a realignment of plan, with contour streets for a substitute, and there are about five per cent who are vigorously protesting. As a unanimous agreement is necessary it is very likely that the rectangular street plan will be adhered to, and street work on this basis be at once ordered, unless the minority can quickly be convinced of the desirability of the change.

In the meantime this unsettled question has delayed street work and building improvements in this region, which will now be served by a rapid transit line through the Twin Peaks Tunnel.

Car Barn: Since the completion of the lines constructed under the 1913 Bond Issue, there have been bought 21 street cars of the light weight type in use on Union Street and 20 cars of the larger type in use on Geary Street. The increased service on the H, J, K and L lines has involved the employment of additional men working from the Potrero Car Barn. In order to house the cars and to provide for the men, there is now being completed a portion of the second story, composed of a four track barn along Hampshire Street from 17th to Mariposa Streets and an office portion together with club and locker rooms for the men along the Mariposa Street frontage. The capacity of the barn has been increased to care for 32 additional cars, making a total of 140. The Geary Street barn has a capacity for 120 cars.

At the present time we have 188 large, double-truck cars, 21 cars of the single-truck Union Street type, one electric locomotive purchased for operating the Ocean Shore Railway, and three service cars, making a total of 213 cars. We also have 10 automobile busses, 3 service trucks and 3 automobiles.

New Projects

I am listing below, in tabulated form, projects which have been brought before you and which should receive consideration. I have numbered these consecutively in the order of their relative importance. The table shows the length of new railway route to be constructed, the cost of the track, and cost of auxiliary features necessary. The auxiliaries are: a car barn for the Duboce-Sunset route, the construction of the Bernal Cut and securing of a right of way and construction of a viaduct for the Excelsior District line, a viaduct on the Balboa Street line, the acquisition of right of way and construction of retaining walls and rearrangement of streets on the Eureka Street line. I have also included the cost of new cars necessary to operate these proposed extensions. The last column indicates the total cost of each of the items. The table follows.

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WASHINGTON, D. C.

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GOLDEN GATE

LEGEND

- Existing Market St Ry Tracks
- California St Cable Ry Tracks
- Municipal Ry Tracks
- Municipal Ry Bus Lines
- Proposed Municipal Ry Tracks
- Municipal Ry Bus Lines
- Municipal Ry Tunnel Lines

MAP
OF THE
CITY AND COUNTY OF
SAN FRANCISCO

1924

M.M.O'SHAUGHNESSY
CITY ENGINEER

To Accompany
Report of the City Engineer
on Municipal Railway
Extensions
Feb 27-1925

BAY OF SAN FRANCISCO



PACIFIC OCEAN

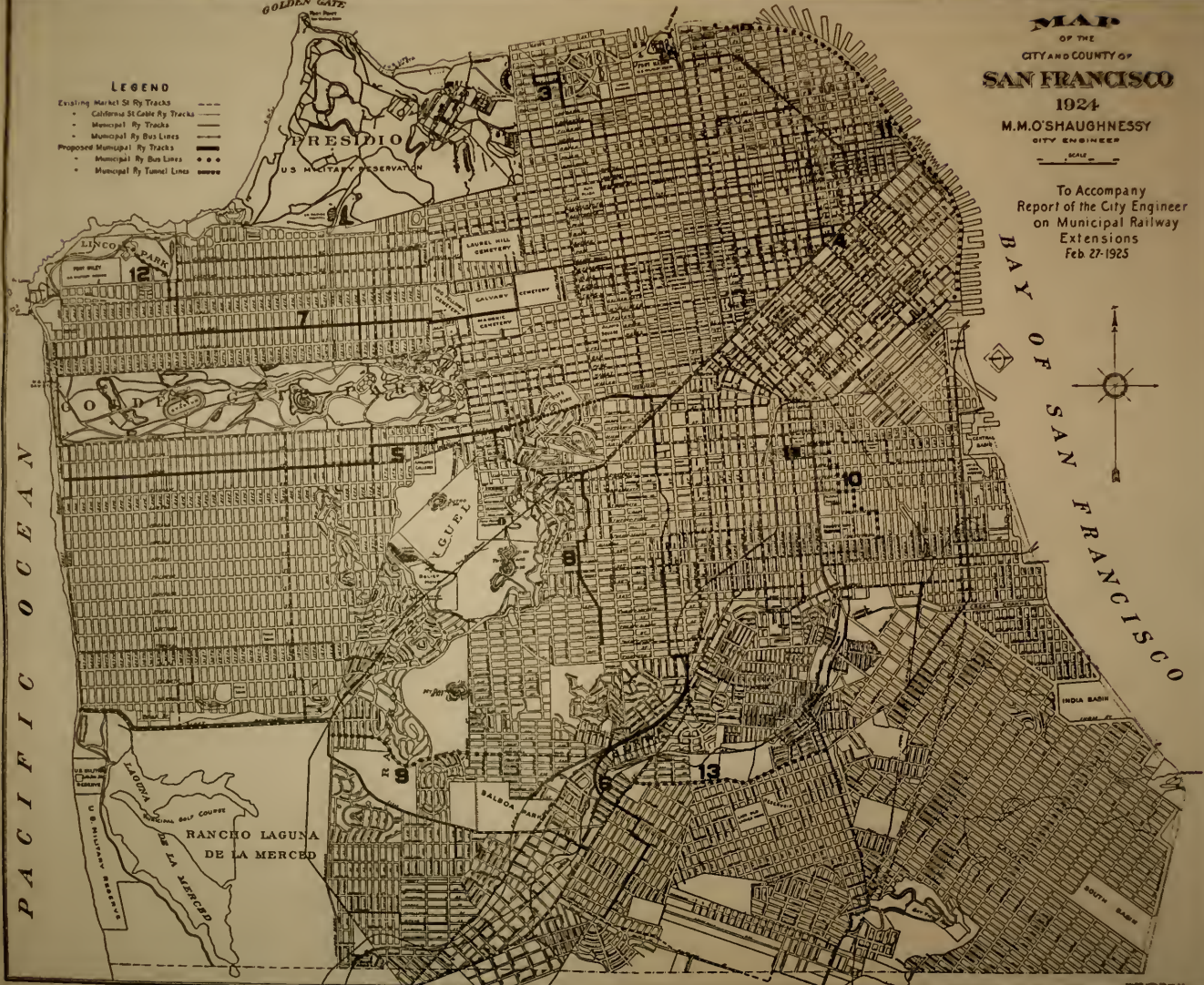


Table Showing New Projects

No.	Description	Route Miles	Estimated Cost			
			Track	Auxiliaries and Land	Equipment	Total
1	Car Repair Shop			\$ 250,000		\$ 250,000
2	New Cars (15)				\$255,000	255,000
3	Marina Tract	.69	\$ 60,000			60,000
4	Downtown Loop	.19	70,000			70,000
5	Duboce-Sunset	4.54	567,000	400,000	289,000	1,256,000
6	Excelsior District	2.73	343,000	1,600,000	102,000	2,045,000
7	Balboa St.	2.79	355,000	100,000	85,000	540,000
8	Eureka St.	1.60	200,000	625,000	200,000	1,025,000
9	Monterey Blvd. (Bus)	1.25			20,000	20,000
10	Potrero Hill (Bus)	1.10			30,000	30,000
11	Embarcadero (Bus)	3.25			60,000	60,000
12	Legion of Honor (Bus)	.60			10,000	10,000
13	Silver Avenue (Bus)	1.47			30,000	30,000
			\$1,595,000	\$2,975,000	\$1,081,000	\$5,651,000

Immediate Necessities:

The following four projects are immediate necessities of the railway and must not be set aside in order that extensions may be made into new territory.

1. Car Repair Shop:

On March 12, 1923, your Board passed Resolution No. 20,885 (New Series), ordering the City Attorney to commence condemnation proceedings to secure the block of land bounded by Mariposa, Bryant, 17th and York Streets. You were also requested to close York Street between Mariposa and 17th Streets, making with the above block a plot 280x400 ft. adjoining the Potrero Car Barn. On this land we proposed to erect a Car Repair Shop, Paint Shop, Material Yard and other facilities necessary to satisfactorily continue the operation of our Municipal Railway.

Provisions were made in the original Geary Street Car Barn for a small repair shop to take care of the 43 cars originally purchased. We now have 213 cars, automobile busses and other equipment which must be maintained. Our track has also grown from 15 to 70 miles in length. No addition has been made to the original shop space and now it is becoming impossible to keep up the work which must be done. We have been working with a makeshift paint shop. No provision was ever made for a track and trolley maintenance shop, store and yard, resulting in a resort to various expedients to get maintenance of way work performed. The amount of this work is increasing continuously, and we must have

facilities to handle it. Therefore it is my recommendation that the Car Repair Shop be given primary consideration.

2. New Cars:

I have already presented to you a request endorsing that of our Superintendent, Mr. Boeken, for new cars. About a year and a half ago we purchased 20 cars. Considerable improvement in service has taken up a number of these cars, while the operation of a through service on the "L" line has taken 9 more cars, so that today we find ourselves with fewer spare cars than we had at the time we purchased the 20. It is desirable to further improve our service, and I have included, as next most important after the construction of the Car Repair Shop, the purchase of 15 new cars at a cost of approximately \$255,000.

3. Marina Tract:

The area occupied by the Panama-Pacific Exposition has been subdivided, streets have been paved, sewers built, and 200 houses are now being constructed, and the whole district is being very rapidly settled. This district is without adequate transportation, although the Municipal Railway is adjacent to it on two sides. By the construction of .69 mile of line—on Scott, to Beach, to Broderick, to North Point, and back to Scott Street—the westerly end of this district can be served from the existing Chestnut Street line. As the Municipal Railway operates the adjacent service, it is our duty to provide this extension, and I would recommend that \$60,000 be appropriated for the construction of this piece of track. We can, contingent on the purchase of the 15 cars recommended above, operate this line without purchasing additional cars.

4. Downtown Loop:

In June, 1922, I directed a communication to the Board of Supervisors through the Board of Public Works, requesting that there be made available from the Municipal Railway funds, money for the construction of a loop in the downtown district. This loop would be around the block bounded by Geary Street, Grant Avenue, O'Farrell and Stockton Streets and should include a connection out of Market Street into Grant Avenue. The total amount of track involved would be .19 mile.

Some of the Municipal Railway Market Street and Geary Street lines now running to the Ferry would be routed over the loop at certain hours of the day. Check of the destination of passengers indicates that such operation would not be an inconvenience to the public, and at the same time would make a considerable saving in the amount of car mileage operated, thereby reducing expense. Now in case of a fire, parade or other interruption of Market Street traffic, the operation of our lines running into Market Street is almost stopped. With this loop we could still maintain good service. Seventy thousand dollars should be provided for this betterment.

I desire to recommend that the sum of \$635,000 be provided at once to construct (1) a car repair shop, (2) fifteen new cars, (3) an extension into the Marina tract, and (4) a downtown loop.

New Car Lines:

The following are desirable and necessary extensions. Funds for their construction should be secured through the issuance of bonds at an early date:

5. Duboce-Sunset Line:

The construction of a tunnel as a rapid transit outlet for the Sunset District necessitates the building of a railway. This line will be routed through either the Duboce tunnel or the Mission-Sunset tunnel, depending upon which is constructed. The figures given are on the basis of the Duboce-Sunset tunnel which will require 4.54 miles of new double track from Market Street to the beach, via Judah Street, at a cost of \$567,000, and a new car barn in the Sunset District costing, with land, approximately, \$400,000. It will also necessitate the purchase of new cars costing \$289,000, making a total of \$1,256,000. The construction of the Mission-Sunset line would not cost so much for track but your Board has passed Resolution No. 23,093 (New Series) assessing the railway for a portion of the cost of the tunnel amounting to \$393,163.60, which would more than offset the small reduction in the cost of the track work.

I have included this line among the projects for a proposed bond issue, although your Board has already set aside out of the Depreciation Reserve, by Resolution No. 19,262 (New Series), the sum of \$500,000 to construct this line. I would recommend that \$400,000 of this appropriation be formally withdrawn and be made available for the first four items of this report. The \$100,000 remaining to be used in laying tracks on Judah Street where street paving and grading is now being done.

I further recommend that Resolution No. 19,263 (New Series), appropriating \$200,000 for the construction of a Masonic Avenue Line, be rescinded. This action will furnish \$600,000 for the Immediate Necessities.

6. Excelsior Street:

Many requests have been made for railway service into the Excelsior District. This is a large territory without any transportation. I am proposing the extension of the Church Street Line through the proposed Bernal Cut, thence via a private right of way and existing streets to Mission and Excelsior Streets. Thence over such streets as will provide feasible grades to a terminal at or near Geneva Avenue. This proposed extension will have a length of 2.73 miles and will cost \$343,000 for railway construction. Construction of the Bernal Cut will cost \$1,400,000, and the proposed new construction between Bernal Cut and Mission Street will cost an additional \$200,000, making a total of \$1,943,000.

7. Balboa Street.

At the present time the Richmond District has car lines on Fulton, Geary, Clement and California Streets. The distance from Fulton Street to Geary Street, which is without car lines, is approximately 2,640 feet.

The growth of this district during the past few years has been phenomenal. The proper handling of the traffic in this district necessitates the construction of a line on Balboa Street from Masonic Avenue to 33rd Avenue. The construction of this line will greatly convenience the public of the Richmond District. With only a nominal increase in the amount of service, we can do considerably more business and operate more efficiently. This line will necessitate the construction of a viaduct across the marked depression in grade at 23rd Avenue. The total cost of this line, including track, viaduct and cars is estimated at \$540,000.

8. Eureka Street:

Many requests have been made for the construction of a line from 17th and Market Streets over or parallel to Eureka Street as far as 29th Street. This line would have a length of 1.6 miles. There has already been submitted to your Board a detailed report under date of May 20, 1924. The track construction would cost \$200,000. The auxiliaries, involving real estate for right of way, grading, retaining walls, and the changing of existing streets, will cost \$625,000. Cars to the value of \$200,000 will be necessary, making a total of \$1,025,000 for this line. As indicated in my report of June 4, 1924, I think it impossible to operate this line and meet all expenses from its earnings.

Other extensions have been before your Board for consideration, but those treated of here are the only ones of immediate concern.

New Bus Lines:

Many requests have been made for municipal bus line service connecting with the street cars, and I am making recommendations on the five routes following:

9. Monterey Boulevard:

St. Francis Wood, Balboa Terrace, Westwood Highlands, Westwood Park and the westerly portion of the Sunnyside Tract, all very closely built up portions of the City, are some considerable distance from a street railway line. The contour of the ground is such as to make it costly to construct and operate a street railway, although an automobile bus could be operated to connect with the railway. A petition for this bus line was filed with your Board on December 17, 1924. This was signed by 600 residents of the districts to be served. Similar petitions have been filed before and the matter of transportation was discussed four or five years ago when this territory was first opened. The length of the line from Junipero Serra Boulevard to Monterey Boulevard and Genesee Street is 1.25 miles. In order to provide service for this route it will be necessary to purchase busses having a value of \$40,000.

10. Potrero Hill Bus Line:

For almost ten years the matter of transportation for the Potrero Hill District has been under consideration. A new petition was filed on January 29, 1925, which contains several hundred names. A new street between Rhode Island and Carolina Streets is under construction and when this is completed, we should operate an automobile bus line

connecting with the Potrero Avenue line of the Municipal Railway at 17th and Potrero Streets, thence over 17th, San Bruno, Vermont, 20th, 22nd and Wisconsin Streets to 23rd Street. The length of this line is 1.10 miles. The cost of the equipment for this service will be \$30,000.00.

11. Embarcadero Bus Line:

In 1917, I made an extensive study and report covering the operation of automobile service around the water front, and the same subject has been up for discussion from time to time, but nothing definite has ever been done. A bus service can be operated around the water front from the foot of Hyde Street to the Third and Townsend Streets Station of the Southern Pacific Company. The length of this line will be 3.25 miles. The cost of the equipment necessary for its operation will be \$60,000.00.

12. Bus Line to Legion of Honor Building:

The Legion of Honor Building in Lincoln Park has recently been opened. No direct car service is within easy reach of this building which is being daily visited by many people. Service should be given by a bus line operating from 33rd Avenue and Geary Street, via 34th Avenue and Lincoln Park. The length of this line would be .6 mile, the cost of the equipment \$10,000.00.

13. Silver Avenue Bus Line:

At the present time the vast area lying between San Bruno Avenue and Mission Street is without any form of transportation. After the completion of the Excelsior District line, as outlined under No. 6, a bus line should be operated over Silver Avenue from Mission Street and Excelsior Avenue to San Bruno Avenue. The length of this line would be 1.47 miles and the cost of equipment would be \$30,000.00.

Recommendations:

1. I desire to recommend that \$635,000 be provided out of the Depreciation Reserve for the construction of (1) a Car Repair Shop, (2) Fifteen New Cars, (3) an Extension into the Marina Tract, and (4) a Downtown Loop. This \$635,000 to be included in the following recommended bond issue for return to the Depreciation Reserve.

2. The total cost of all the Additions and Betterments described is estimated at \$5,651,000. Contingencies and unforeseen difficulties may increase this cost to \$6,000,000. It is my recommendation that your Honorable Board submit to the public a proposal for the issuance of bonds to the amount of \$6,000,000 for the purpose of making these recommended extensions to the Municipal Railway.

3. I recommend that Resolution No. 19,262 (New Series), appropriating out of the Depreciation Reserve the sum of \$500,000 to construct the Sunset line, be repealed and that in its place \$100,000 be set aside to be used in laying tracks on Judah Street where street paving and grading is now being done.

4. It is also recommended that Resolution No. 19,263 (New Series), appropriating \$200,000 from the Depreciation Reserve for the construction of a line on Masonic Avenue, be rescinded.

San Mateo County Extension

The above covers the early additions which will have to be made to the Municipal Railway property. A very valuable future addition to our railway lines will be an extension of the Municipal Railway from a point near the County line, just west of the Ocean View District, into San Mateo County, traversing a route about half a mile west of the State Highway. This will run through a densely settled interurban district and will, I believe, be a paying line from the start. The grades in the Twin Peaks Tunnel and the portion of the Ocean View Extension which will form a part of this line have been kept below three per cent so as facilitate high speed service.

The completion of this line will be a material help in cementing the interests of the two counties and hastening the consolidation of the urban and interurban communities. As yet no estimation of the cost of this line has been made. I would, however, recommend that funds be provided for the making of a survey and the preparation of maps which may be used as a basis for further study of this necessary extension.

Bus Operation

At the present time none of the bus lines which we are operating are taking in sufficient money to meet their operating expenses, not considering fixed charges. All of our bus lines charge a five-cent fare and issue free transfers to the street railway lines with which they connect. It is impossible to expect bus lines so operated to pay. A recent report from the Street Railway Commission of the City of Detroit, which is operating a number of bus lines, indicates that with a ten-cent fare their deficit for the year will be \$100,000. They are operating 30 miles of route, using 50 light type busses, running over two million miles per year. The General Manager of the Detroit Municipal Street Railway System says that if the coach fares are reduced to six cents, which is the fare charged on the railways, that the deficit will be at least \$250,000 per year. These data are from the city which is the heart of the automobile manufacturing industry and indicate the failure of automobile busses to pay their way where the routes operated are fairly level and where the number of passengers carried is fairly high.

In view of the above, we should confine our bus operations to a minimum number of routes which cannot at the present time be served by street railways but which may, at some future date, either be served in some other manner, or which now give evidence of growing sufficiently to warrant the installation of street railways. Many bus lines established at the present time under existing fares would be disastrous financially.

Depreciation Reserve

On February 8, 1915, the Board of Supervisors passed Ordinance No. 3109 setting aside and appropriating 18 per cent of the gross passenger revenues of the Municipal Railway for the purpose of defraying the expenses of replacements, reconstruction and depreciation of the Municipal Railway, and providing for the payment of the bonded indebtedness incurred for the construction thereof. Of the 18 per cent,

14 per cent was to be used for depreciation and bond retirement and 4 per cent for injuries and damage claims. These percentages were arrived at with the assistance of Certified Public Accountant Dolge, working in conjunction with this office. At this time Honorable Thomas Jennings, now deceased, was chairman of the Finance Committee of the Board of Supervisors, and the Honorable Alexander Vogelsang was chairman of the Public Utilities Committee. These percentages represented logical and proven amounts necessary to properly take care of railway property. A detailed report of the Depreciation Fund as it stands today is being submitted by your accountant Mr. Bullock. This will show that 18 per cent of the gross passenger revenue, plus the interest on such of this fund as has been invested in bonds, is almost $5\frac{1}{4}$ million dollars. A very small amount has been expended in taking care of accrued depreciation. Over \$400,000 have been paid out on account of injuries and accident claims. Over \$1,600,000 have been used to retire bonds. More than a half million dollars have been transferred to the Operative Fund in order to make up operating deficits. Almost \$1,200,000 have been expended on Additions and Betterments, leaving in the fund at the present time close to \$1,200,000 of which almost \$1,000,000 is invested in bonds drawing interest.

It is interesting to note that the City of Toronto, Canada, which has assumed the ownership of its municipal railways, is writing off depreciation at the rate of \$877,000 per annum, which is $7\frac{1}{2}$ per cent of the gross annual income which is \$11,800,000, or 2 per cent of the value of the property which is \$43,000,000.

The present value of the Municipal Railway is close to \$12,000,000. Today the Depreciation fund does not exceed 10 per cent of this amount yet it is the net accumulation of the annual reserves set aside since the commencement of the operation of the road in 1912 plus interest on the money invested in bonds. This is in the neighborhood of 1.2 per cent of the value of the railway per annum. It was the intention of Supervisors Jennings and Vogelsang that the portion of the fund set aside by Ordinance No. 3109 which was not used for damage claims or for retirement of bonds should be kept intact to meet the expense of maintaining the road in 100 per cent operating condition. So far the railway has not been in operation long enough to accrue depreciation necessitating heavy expenditures but in a very short while it will be necessary to commence replacing worn out track and the sums which will have to be spent for this work will be of no inconsiderable magnitude.

It will be well also to bear in mind that the earthquake disturbance of 1906 caused the expenditure of over \$6,000,000 by the Market Street Railway Company, and it would be only good prudent policy for the City to keep an adequate reserve to meet such a future contingency.

Respectfully submitted,

M. M. O'SHAUGHNESSY,

City Engineer.

Bus Operation:

The Municipal Railway is at the present time operating bus lines along two routes with a total length of 5.42 miles. One line runs on the Great Highway along the Ocean front, the other across Golden Gate Park from the Richmond district into the Sunset district. The fare on these lines is five cents including a transfer to the Municipal Railway cars. During the year the receipts from the bus lines totaled \$55,172.67 and the operating expenses, \$72,160.50, making a net loss of \$16,987.83, or \$46.54 per day.

Street railways all over the country are adding bus lines as feeders along lean routes, and during the present year the reports indicate that more than 2,000 of them were purchased. In most cases the railways are requiring a separate fare on the bus, in an attempt to at least make the revenue meet operating costs. From the tabulation of rates of fare given above it is to be noted that a fare of 10 cents or more is charged on all of the bus lines with the exception of a few short lines operating in New York City.

The statement is often made in the public press that the electric car will be replaced with automobile busses at an early date. This is not the view of the railway operators who appreciate that busses are useful auxiliaries but that they are limited in the amount of traffic which they can handle. The cost of operating a bus about equals the cost of operating a street car, and when the headway required of the busses falls below 15 minutes, and where the loading is such as to utilize the seating capacity of the busses, it is as cheap to install rails and operate electric cars which have a markedly greater capacity. Where the headway is short and the traffic dense, it is entirely out of the question to consider the bus in comparison with the electric car. Under San Francisco conditions, the main street car lines can never be abandoned in favor of the rubber tired vehicle. In planning for the future of San Francisco the electric railway must be considered as the most efficient vehicle which can be used on the city streets for mass transportation.

Contracts:

Contracts for installing electrical conductors and for track bonding on the Ocean View line were let during the year and work is proceeding satisfactorily. The laying of track under the contract let last year is about completed and paving will be commenced as soon as the bonding is completed. Status on the contracts under way during the year are given in the following tables:

Date		Particulars	Debit	Credit
1890	Jan 1	Balance		100.00

1890	Jan 1	Balance		100.00
1890	Jan 15	By Cash	50.00	
1890	Jan 20	To Cash		25.00
1890	Feb 1	By Cash	75.00	
1890	Feb 10	To Cash		30.00
1890	Feb 25	By Cash	60.00	
1890	Mar 5	To Cash		40.00
1890	Mar 15	By Cash	80.00	
1890	Mar 25	To Cash		50.00
1890	Apr 10	By Cash	90.00	
1890	Apr 20	To Cash		60.00
1890	Apr 30	By Cash	100.00	
1890	May 10	To Cash		70.00
1890	May 20	By Cash	110.00	
1890	May 30	To Cash		80.00
1890	Jun 10	By Cash	120.00	
1890	Jun 20	To Cash		90.00
1890	Jun 30	By Cash	130.00	
1890	Jul 10	To Cash		100.00
1890	Jul 20	By Cash	140.00	
1890	Jul 30	To Cash		110.00
1890	Aug 10	By Cash	150.00	
1890	Aug 20	To Cash		120.00
1890	Aug 30	By Cash	160.00	
1890	Sep 10	To Cash		130.00
1890	Sep 20	By Cash	170.00	
1890	Sep 30	To Cash		140.00
1890	Oct 10	By Cash	180.00	
1890	Oct 20	To Cash		150.00
1890	Oct 30	By Cash	190.00	
1890	Nov 10	To Cash		160.00
1890	Nov 20	By Cash	200.00	
1890	Nov 30	To Cash		170.00
1890	Dec 10	By Cash	210.00	
1890	Dec 20	To Cash		180.00
1890	Dec 30	By Cash	220.00	
1890	Total		2200.00	2200.00

CURRENT CONTRACT DATA, 1924 - 25

LOCATION	CONTRACTOR	Date of Award	Date Completed	Per cent Completed	Amount of Completed Contract	Amount Expended to June 30, 1925	FUNDS
<u>BOULEVARDS, PAVING AND GRADING</u>							
El Camino del Mar (Lincoln Park Blvd)	Jas. R. McElroy	2/ 8/23	10/15/24	100	\$109,612.57	\$109,612.57	County Roads
Collingwood, 21st and 22d Streets (Paving)	Municipal Construction Co.	10/19/23	12/ 3/24	100	30,827.03	30,827.03	General Fund
Buchanan Street Bermann St. to Duboce Avenue	Jas. R. McElroy	10/24/23	8/13/24	100	39,955.75	18,000.00 a	Public Assessment and County Roads
Silver Avenue Merrill St. to Vienna St.	Municipal Construction Co.	2/29/24	8/18/24	100	32,671.85	22,365.28 a	Public Assessment and County Roads
Marina Boulevard (Tonquin St.)	Municipal Construction Co.	4/21/24	3/ 4/25	100	56,488.70	56,488.70	County Roads
San Jose Avenue Havelock St. to Cotter St.	Municipal Construction Co.	5/19/24	1/28/25	100	12,892.43	12,892.43	County Roads
Geary Street Mason St. to Van Ness Avenue (Widening)	City Construction Co.	8/ 8/24		15	20,601.89	2,000.00 b	General Fund and Special Fund
Harding Golf Links (Lake Merced) Road	H. T. Guerin	10/24/24		100	34,156.74	29,000.00	County Roads
Virginia Avenue Mission St. to Coleridge St.	Jas. M. Smith	11/17/24	4/19/25	100	6,009.23	6,009.23	County Roads and District Assessment
Avalon Avenue, London and Paris Streets (Paving)	Municipal Construction Co.	12/17/24	3/25/25	100	14,801.71	14,801.71	County Roads
Southern Heights Boulevard (Grading and Walls)	Jas. M. Smith	1/12/25		100	14,175.67	11,050.00	County Roads
Fulton, Leavenworth and Market Streets Intersection	O. B. Eaton	3/25/25		30	6,317.01		General Fund
Roosevelt Way (Grading and Walls)	Schultz Construction Co.	5/11/25		15	67,405.76	6,000.00	County Roads
Pulgas Road (Grading)	Farrar and Carlin	5/22/25		7	42,805.45	2,513.63	Tubercular Sanitarium Fund

a Balance paid by public assessment on property.

b Geary Street Property Owners' Association's Contribution.

CURRENT CONTRACT DATA, 1924 - 25

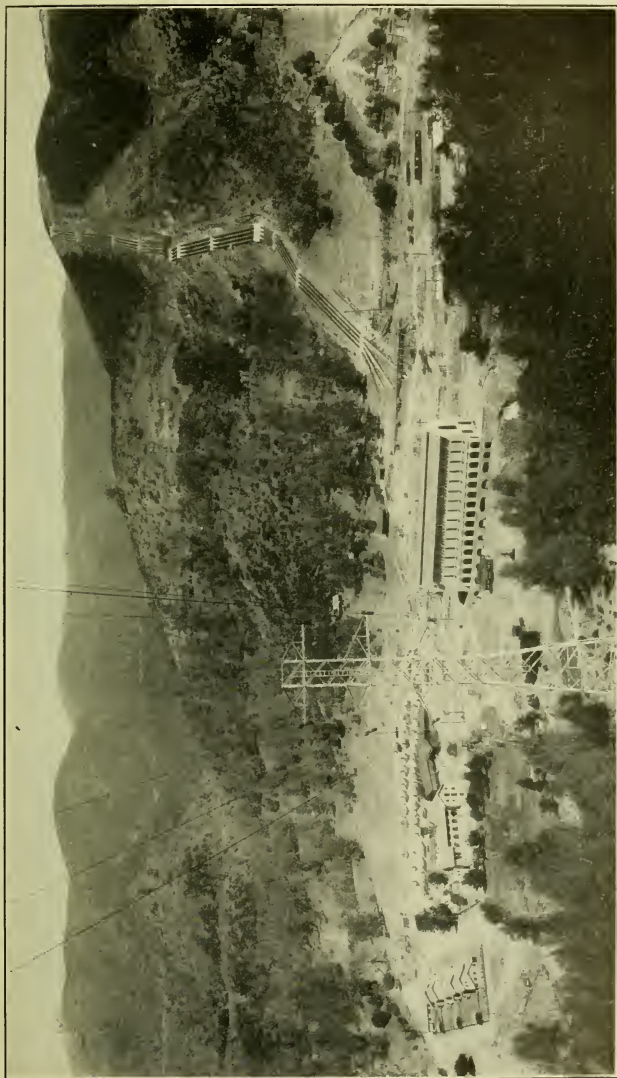
NO.	LOCATION	CONTRACTOR	Date of Award	Date Completed	Per cent Completed	Amount of Completed Contract	Amount Expended to June 30, 1925	FUND
<u>MUNICIPAL RAILWAYS</u>								
133	17th St. Car Barn - Second Story	Vukioevich & Bagge	9/19/24	2/27/25	100	\$139,675.30	\$139,675.30	Mun. Ry. Depreciation
138	Ocean View Line - Track & Paving	Eaton and Smith	4/10/25		42	104,917.77	33,000.00	Mun. Ry. Depreciation
140	Ocean View Line - Concrete Trolley Poles	Jas. M. Smith	5/ 2/24	9/ 8/24	100	16,219.34	16,219.34	Mun. Ry. Depreciation
142	Ocean View Line - Installing Electric Conductors	Robt. W. Jamison	10/ 3/24		90	8,236.31	5,715.00	Mun. Ry. Depreciation
143	Ocean View Line - Track Bonding	Robt. W. Jamison	5/ 8/25		40	3,038.23	936.73	Mun. Ry. Depreciation

SEWERS

Great Highway Sewer, Ortega to Rivera Street	L. J. Cohn	9/ 5/24	12/ 3/24	100	19,487.25	19,487.25	General Fund
Great Highway & Vicente Street Outfall Sewer	Peter J. McHugh Jr.	2/ 9/25		75	40,293.94	18,450.00	General Fund
30th Avenue and Kirkham St. Sewer	L. J. Cohn	4/17/25		30	45,999.00	10,050.00	General Fund
Harding Golf Links Sewer	Spring Valley Water Co.	4/20/25		100	11,965.63		General Fund

MISCELLANEOUS

Concrete Parapet Roadway- Sutro Heights	Jas. M. Smith	7/25/24	12/ 3/24	100	7,088.24	7,088.24	County Roads
Street Signs (Contract No. 4)	M. J. Lynch	9/22/24	2/25/25	100	8,435.00	8,435.00	General Fund
3d St. and Islais Creek Bridge Traffic Gates & Signals	Butte Electric & Mfg. Co.	6/17/25			4,351.30		General Fund



MOCCASIN POWER PLANT, HETCH HETCHY WATER SUPPLY

General view showing penstock pipes from power tunnel, power house, operators' quarters and club house, construction camp, and beginning of transmission line to San Francisco.

HETCH HETCHY WATER SUPPLY

Progress and Development

The fiscal year 1924-1925 has been marked by the completion of the Mountain Division of the Hetch Hetchy Aqueduct and the operation of Moccasin Power Plant with its transmission line to San Francisco Bay. The Bay Development has been completed with the exception of the submarine portion of the line and its connections to the 60-inch riveted pipe. A contract for temporary distribution of electric power has been entered into between the City and the Pacific Gas and Electric Company under which the Company, acting as the City's agent, will distribute the output of the Moccasin Power Plant, yielding the City in excess of \$2,000,000 annually. This sum is sufficient to pay the operating expenses and the interest on the outstanding bonds chargeable to the Mountain Development as now completed.

The completion of the Mountain and Bay Developments leaves still to be built 95 miles of aqueduct from Moccasin Power House to Irvington, which will connect the two constructed sections of the aqueduct and make an unbroken line from Early Intake to Crystal Springs.

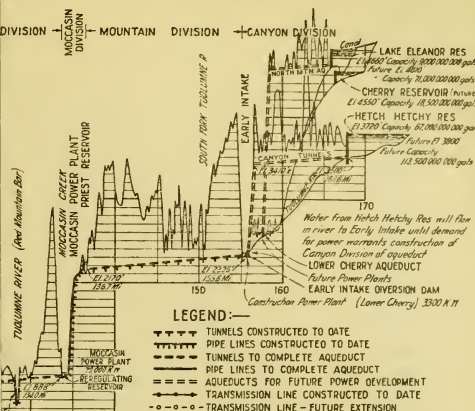
This work can be completed in five years, provided adequate finances are made available and the construction work is not retarded by failure of the Supervisors to enact the proper ordinances authorizing finances and the construction program as required.

With the rapidly increasing consumption of water in the city it is essential that the work be carried on continuously and as expeditiously as possible in order that the aqueduct be completed and Hetch Hetchy water brought in to augment the supply now available from local sources, which cannot safely be depended on to be sufficient for our needs for more than six years. Severe restrictions on the use of water would have been necessary last year but for the early occurrence of heavy rains. It would be very shortsighted policy to court repetition of such a condition by neglecting to carry the aqueduct construction to completion without undue delay.

A bond issue of \$10,000,000 to prosecute work in the Foothill and Coast Range Divisions was authorized by the electorate on October 7, 1924, by a vote of 68,549 for as against 3361 opposed. A further bond issue of \$24,000,000 will be necessary to complete the work between Moccasin and Irvington, which should be available within the next two or three years.

Preparations for the construction of the aqueduct tunnels in the Foothill and Coast Range Divisions are in progress and the work now awaits action of the Board of Supervisors to make available funds requested by the City Engineer in November, 1924.

A serious and costly interruption to the work occurred in December, 1924, when the Acting Mayor attempted to order suspension of work on a large part of the Mountain Development, pending arrangements being made for financing completion of the work. Due to the action



LEGEND:

- T T T T T T TUNNELS CONSTRUCTED TO DATE
- — — — — PIPE LINES CONSTRUCTED TO DATE
- — — — — TUNNELS TO COMPLETE AQUEDUCT
- — — — — PIPE LINES TO COMPLETE AQUEDUCT
- — — — — AQUEDUCTS FOR FUTURE POWER DEVELOPMENT
- — — — — TRANSMISSION LINE CONSTRUCTED TO DATE
- - - - - TRANSMISSION LINE - FUTURE EXTENSION

All elevations refer to Hetch Hetchy Datum, which is approximately 125 feet above U.S.G.S. Datum and 773 feet below S.F. City Datum.



HETCH HETCHY WATER SUPPLY OF THE CITY AND COUNTY OF SAN FRANCISCO, CALIFORNIA.

GENERAL MAP AND PROFILE

DEPARTMENT OF PUBLIC WORKS

APPROVED Will Shaeffer CITY ENGINEER.

JANUARY 1925 B-379

of a public spirited citizen an injunction was secured in the Superior Court, presided over by Judge Johnson, against such manner of handling a great civic project.

In a report to the Grand Jury on December 1, 1924, by the City Engineer, it was clearly shown that over \$1,600,000 had been received from gross receipts of the Hetch Hetchy Railway and temporary power plant, of which only \$334,059.72 had been restored to replenish the construction fund. There was a balance, therefore, properly available of \$1,265,940.28 which would be useful for further construction if not diverted to non-water purposes by the Finance Committee.

It was also plainly shown that \$2,980,326.55 was the discount loss in converting the Hetch Hetchy $4\frac{1}{2}\%$ 45 million dollar bond issue to a $5\frac{1}{2}\%$ basis.

It was further shown that the accumulated interest on invested Hetch Hetchy funds yielded \$2,540,705.95 to the city, no portion of which has ever been placed where it properly belongs, to the credit of the bond funds for water construction purposes, but it has been diverted for other civic uses.

Contracts:

Specifications prepared and contracts awarded during the fiscal year were as follows:

Contract No. 105, for the construction of submarine pipe lines at Dumbarton Strait and Newark Slough, in the Bay Crossing Division of the Hetch Hetchy Aqueduct. This contract covers the laying of cast iron flexible jointed pipe, 42 inches in diameter, across navigable channels of San Francisco Bay, to connect sections of the 60-inch riveted steel pipe constructed under Contract 90 between Irvington and Crystal Springs Reservoir.

Contract No. 107, for furnishing, delivering and erecting steel bus structure for the Moccasin Power Plant.

Contract No. 108, for the construction of wood cover over portions of the Bay Crossing Pipe Line, Hetch Hetchy Aqueduct. Under this contract the section of the 60-inch riveted steel pipe line which is supported on trestle over the marsh between Newark and Dumbarton Strait was covered with a housing to reduce the effect of changes of temperature by shielding the metal from the direct sunshine.

Further details as to these contracts and the work done by the contractors will be found in the description of construction work later in this report. A table of statistics of Hetch Hetchy Water Supply contracts in force during the fiscal year is included in this report. Similar statistics covering contracts accepted previous to July 1, 1924, have appeared in previous annual reports and are not repeated here.

Organization and Headquarters Work

The organization continues under the general direction of City Engineer M. M. O'Shaughnessy, whose Chief Assistant Engineer, Nelson A. Eckart, has direct supervision over all work on the water and power development.

City Headquarters Office:

The City Office staff designs all projected work, prepares plans and specifications for all work done, selects and purchases equipment for day labor work and cost-plus-fee contracts, prepares maps and descriptions of lands and rights of way, and checks and passes for payment all bills and payrolls. The staff personnel includes: R. P. McIntosh, L. W. Stocker and R. J. Wood, Civil Engineers; P. J. Ost, Electrical Engineer; E. P. Jones, Mechanical Engineer; H. W. Kephart, Purchasing Agent; and other employees. During the fiscal year, with the completion of a number of major elements of the project, the office and field forces were very materially reduced as the volume of work diminished.

Field Headquarters:

Field organization has continued substantially the same as for the previous year. L. T. McAfee, as Construction Engineer at Groveland, has had charge of all construction east of the San Joaquin River and of the power transmission line west to San Francisco Bay, while C. R. Rankin, at Palo Alto, has been Construction Engineer of the Bay Development, including the Bay Crossing pipe line and its appurtenant structures.

Field Employees:

The number of employees in the field has decreased from 1387 at the beginning of the year to 358 at the end of the year. Toward the last of June, 1925, men were being laid off very rapidly due to the completion of various units of the work. The following table shows the number of men employed on the different sections of the work on a typical day in June, 1924, and on June 30, 1925:

	June 1924	June 30 1925
Mountain Division tunnels, Moccasin power tunnel.....	325	....
Early Intake Diversion Works.....	60	....
Moccasin headworks.....	.....	36
Moccasin penstocks.....	140	33
Moccasin power house.....	171	78
Hetch Hetchy Railroad.....	91	13
Lower Cherry power system.....	8	8
Foothill Division tunnel surveys.....	.....	8
Bay Crossing pipe line.....	75	20
Dumbarton Strait bridge.....	95	46
Dumbarton Strait submarine pipe line.....	.....	38
Transmission line.....	225	....
*General and Miscellaneous.....	197	78
Totals	1387	358

*This item includes field engineering forces, employees at Groveland headquarters, hydrographer at Mather, caretaker at O'Shaughnessy Dam, and a number of comparatively small jobs.

The above figures include both direct employees of the City and employees of contractors, but do not include employees in the San Francisco office.

Groveland Headquarters:

Few changes were made in the personnel of the Groveland Headquarters staff during the fiscal year, the men released from completed work being required in connection with new work, particularly in the preliminary surveys and estimates for the Foothill Division Tunnels.

Hospital: The City continued to maintain at Groveland a fully equipped hospital with a capacity of seventy-five patients. A physician and three trained nurses constitute the staff.

Cases treated at the hospital during the past fiscal year were as follows:

Non-hospital cases	833
Hospital cases:	
City's direct employees.....	311
Construction Company of North America (Tunnel contract)	60
Outside pay patients.....	141
Total hospital cases.....	512
Total cases treated.....	1395
Capital operations	149
Average time in hospital for hospital cases (days).....	15.2

Groveland Water Supply: Water supply for the City's headquarters, shops, and other requirements at Groveland is still obtained from the main aqueduct through the shaft at Second Garrote. Upon the completion of the concrete lining of the tunnel, a Luitweiler deep well pump with 18-inch stroke and capacity of 57 gallons per minute was set up at the collar of the shaft. It pumps from the tunnel level through a 7-inch pipe casing installed in the 3-foot concrete pipe set in the backfill of the shaft, delivering the water to the tanks above Groveland, a lift of 854 feet. The 5½ inch by 8 inch Gould pump in the tunnel was removed when the new pumping equipment was installed.

Lake Eleanor Road

A severe storm in January washed out several portions of the road from Hetch Hetchy to Lake Eleanor. The damage was repaired by a small crew in the spring.

Mather Sawmill

The sawmill at Mather was not operated during the fiscal year and the stock of lumber on hand was shipped to the Groveland warehouse for distribution. A caretaker, kept at the mill throughout the year, had charge of the mill, the City's campsite, and other City properties in this vicinity, and has assisted in handling the visitors to the dam during the tourist season.

Hetch Hetchy Railroad

Traffic on the Hetch Hetchy Railroad decreased rapidly during the fiscal year, on account of the completion of successive units of construction from Moccasin east to Early Intake.

Steam passenger service between Mather and Damsite was discontinued on September 6, 1924, and passenger service east of Groveland was discontinued January 1, 1925.

On February 15, 1925, the Hetch Hetchy Railroad ceased operation as a common carrier, and all scheduled service was discontinued on March 21, on which date the United States Mail Service released the City from its mail contract. On June 1 all steam service was discontinued. Occasional runs of motor freight or passenger cars were sufficient to serve the work during June.

Service between Mather and Hetch Hetchy was temporarily re-established on June 1, 1925, using gasoline motor cars, to provide passenger service and handle the excursion parties from Yosemite Valley. During the month of June, 1748 passengers made the trip to Hetch Hetchy.

Week-end excursions of civic and fraternal organizations from San Francisco to Hetch Hetchy were continued until the fall of 1924. The first-hand information of the nature and quality of the construction work obtained by representative citizens on these trips has been held one of the most potent factors in securing the overwhelming vote in favor of the water bonds in October, 1924. Owing to the discontinuance of steam service on the railroad, no such trips are contemplated for the summer of 1925.

O'Shaughnessy Dam

No construction has been done at the dam during the year. Owing to the extreme drought of 1923-1924, the most severe in the history of the state, the reservoir did not become completely filled in the spring of 1924, but nevertheless the City had such a surplus of water in storage that it was able to sell to the Turlock, Modesto and Waterford Irrigation Districts 108,500 acre feet of water for a total price of \$162,750. The cost of the water was repaid many times over to the irrigationists in the form of increased crops made possible by the use of the additional water.

Lake Eleanor

One man is maintained at Lake Eleanor, who operates the gates for the release of stored waters for the operation of the Lower Cherry Power Plant under the direction of the Chief Operator. He also acts as observer in cooperation with the United States Weather Bureau, and also at regular intervals reads the stream gage at Cherry Valley.

Mather Vacation Camp

The sawmill camp at Mather commenced operating during July and August, 1924, as a vacation camp by the Playground Commission and was such a marked success that its activities were enlarged for the summer of 1925. Hetch Hetchy Lodge, and group of buildings, the

summer resort conducted by the Yosemite National Park Company, was purchased by the Playground Commission as an addition to the camp.

Early Intake Diversion Works

Water for the Moccasin Power Plant, from the wheel pits of which it will ultimately pass on to San Francisco for its domestic water supply, is diverted from the channel of the Tuolumne river at a point known as Early Intake, twelve miles below O'Shaughnessy dam and 156 miles east of San Francisco, measured along the aqueduct line. This point is so named from the fact that in the early stages of the development the water there first enters the aqueduct on its way to San Francisco. At such time in the future as the increased power demands dictate, the water released from both the Hetch Hetchy Reservoir and from Lake Eleanor Reservoir will pass directly into the aqueduct in order to utilize to the fullest extent the difference of level between those reservoirs and the water surface above the Intake diversion dam. The flood waters pass over the spillway to the north of the dam.

The diversion works consist of an arch dam, with spillway, and head-gates structure at the tunnel intake. The dam is of pure arch type with thin section, the crest elevation is 2356, the length 262 feet and radius of arch 100 feet. The thickness at the crest is 6 feet and at the base 13 feet. The total height of the dam is 81 feet from its foundation, which



EARLY INTAKE DIVERSION DAM. HETCH HETCHY WATER SUPPLY

View up Tuolumne River. Flume (on left) discharges water from Lake Eleanor and Cherry River. Gatehouse on right is the inlet to 18.8 mile aqueduct tunnel to Priest Reservoir. Spillway (on left) with automatic gate bypasses flood waters.

was excavated to a point 26 feet below the original riverbed. On the south or left bank of the stream the arch abuts against the solid granite bedrock; on the north, however, it was necessary to construct a concrete abutment for the arch—a solid monolith block containing 3611 cubic yards.

The spillway, which is 130 feet in width with a capacity of 20,000 cubic feet per second, lies between the abutment and the north bank of the stream. The lip of the spillway is at elevation 2341, 15 feet above the tunnel invert, but by means of a series of five radial automatic siphon-operated gates, the water surface above the dam may be raised five feet in periods of low water flow, the gates dropping with the rise of water to a predetermined point to pass the flood and again automatically rising when the flood has passed.

After the completion of the spillway section in the spring of 1924, concrete work was resumed September 10, 1924, on the diversion dam arch, the foundation for which had been completed to bedrock in November, 1923. During the low water season in the fall, this arch was completed, except for two openings 18 inches wide at the face of the dam, with keyways at the points of zero bending moment. During the extremely cold weather of November, while the arch was at maximum contraction, these two openings were filled with concrete. Two openings, 3 feet by 3 feet at river elevation, were fitted with sluice gates for use in blowing off sand from the bottom of the reservoir through 3 foot diameter conduits. Following the completion of the dam proper, the headworks structure, which supports the screen racks and houses the gates that control the flow of water through the tunnel, was constructed, being completed February 28, 1925.

A sand trap 32 feet in length and 5 feet in width and depth is provided in connection with the structure for passing accumulations of sand through a 12-inch diameter pipe through the dam. Ordinarily this will be closed but may be kept open in times of flood. Inclined screen racks prevent brush or other floating trash entering the tunnel. Nine sluice gates, each 4 feet by 5 feet, arranged in two terraces, serve to regulate the flow of water into the tunnel. The operating mechanism for the gates is enclosed in a reinforced concrete housing surmounting the structure; protection from loose rock or boulders which may roll down the mountain side is afforded by a concrete wall above the building.

Following are the concrete quantities involved in the construction of the diversion works:

Spillway section.....	5,013 cu. yds.
Dam foundation below stream bed.....	2,632 cu. yds.
Dam above foundation.....	4,083 cu. yds.
Buttress block forming north abutment.....	3,611 cu. yds.
Headworks	1,225 cu. yds.
Total	16,564 cu. yds.

Both the coarse and fine aggregate for the concrete at the diversion dam were obtained from the spoil bank of the main tunnel. This material, which was hard granite, was crushed and screened and hauled by truck half a mile from the dump to the dam site.

The Lower Cherry Aqueduct has been extended easterly 2,050 feet by wooden flume to discharge the conduit water from Cherry River and Eleanor above the Early Intake diversion dam to be conducted through the Mountain Division tunnel to Moccasin Power Plant.

All of the work at Early Intake was done by day labor under the direction of the City Engineer.

Mountain Division Aqueduct

During the past fiscal year the Mountain Division tunnel, 19 miles long, from Early Intake to Priest Reservoir was completed and put into service. The work of concrete lining the tunnel was performed by Messrs. Webb and Cox of the Universal Concrete Gun Company, under sub-contract from the Construction Company of North America which had undertaken the tunnel construction under a cost-plus-fixed fee contract, (Contract 77-C).

Early Intake:

Five hundred and sixty-four feet of lining was placed by hand in the 3,000 feet of length of tunnel extending from the original tunnel line to the diversion dam. A sand trap was constructed at the junction of the extension and the original tunnel, and the tunnel leading to the old portal which served as an adit to drive the extension, was sealed with a concrete plug, through which is a 5 foot diameter manhole and a 12 inch diameter blow-off pipe leading from the sand trap. This work was all done by day labor under the City Engineer's direction.

South Fork:

At South Fork 494 feet of tunnel was lined with concrete and concrete piers were built to support the 9 foot 6 inch diameter steel pipe crossing the South Fork of the Tuolumne River, and the pipe itself was installed, connecting the aqueduct tunnels east and west of this crossing. The pipe is of steel plate one-half inch thick, with triple-riveted double butt-strap longitudinal joints and double-riveted single butt-strap circumferential seams. The length of pipe installed is 225 ½ feet, of which about 37 feet is imbedded in the two concrete anchors at the points of junction with tunnel. The anchors contain 217 cubic yards of concrete. The pipe is self-supporting between piers, acting as a continuous beam of four unequal spans, the longest span being 74 feet across the main river channel. Three concrete piers, 4 feet by 12 feet on top, and respectively 12.2, 12.6 and 18.1 feet in height, heavily reinforced, were constructed on bedrock. Reinforcement is grouted into holes drilled into bedrock. A 12 inch diameter blow-off pipe with valve extends from a sand trap depressed in the bottom of the tunnel just upstream from the pipe. The main pipe crossing the stream is covered with heavy timber as a protective fender from rock fragments falling from the vertical cliffs above.

The transportation of the pipe sections, averaging 20 feet in length and weighing about 10 tons each, down the narrow, rocky road from Hetch Hetchy Railroad to the tunnel portal presented some difficulties, which were overcome by loading the pipe on a sled and an improvised logging truck constructed on the job, and drawn by an electric hoist mounted on a 5-ton truck.

The paint on the pipe was applied in three coats: first, biturine priming solution; second, biturine enamel, applied hot with a brush; third, (on the outside only), an aluminum paint containing finely divided metallic aluminum in oil, this latter drying with a high silvery lustre which, by its property of reflecting heat, helps to keep the asphaltic coating cool and to minimize the expansion and contraction of the pipe due to temperature changes. An expansion joint at a point of contraflexure in the pipe provides for longitudinal movement due to such temperature changes.

The installation of the pipe including the construction of the piers and anchors was all performed by day labor under the Engineering Department. The crossing was completed ready for service on May 2, 1925.

Adits 5-6 and 8-9:

Working from Adit 5-6, lining was placed in 75 feet of the sides and arch of the aqueduct tunnel, including a 30-foot section 1200 feet east of the adit and 45 feet at the adit. This adit, like that at Early Intake previously described, was sealed with a concrete plug with 5-foot manhole and 12-inch blow-off. Adit 8-9 was similarly plugged on completion of the invert lining east of that point, November 13, 1924, and this adit was lined with concrete in sides and top to prevent caving.

Constructing Concrete Tunnel Lining From Big Creek and Priest Plants:

The concrete lining of the sides and arch of the tunnel between Garrote and Big Creek was completed within 140 feet of Big Creek shaft on September 27, 1924. Before placing this concrete, pockets in the roof, back of timbering left in place, and elsewhere, wherever the concrete placed by the gun could not be expected to fill the cavity, were noted and grout pipes were placed to connect with them through the concrete of the arch. After the concreting was completed, lean grout was forced into the pockets, using the same concrete gun which had been used for the lining, filling them as completely as practicable. The grout consisted of cement and fines from the tailings dumps of some of the old gold mines in the vicinity.

The placing of the concrete invert was carried on following the completion of the sides and arch and the grouting of the pockets in the roof. The method used was the same from Priest and Big Creek camps, differing only as to the manner of ground water control, which varied to meet the condition of advancing the bottom in an upstream or downstream direction.

The method of placing the invert was as follows:

The same portable concrete mixing and placing plant used for lining sides and arch, without the Webb concrete gun, however, was put in position from 250 feet to 500 feet from the point of commencement of work. The track, pipe and muck were then removed from this section and the bottom thoroughly cleaned with brooms. A runway of 2-inch by 12-inch planks was then set up over this section, supported on 4-inch by 6-inch spreaders on 8-foot centers, beveled on the ends to fit the curve of the side walls—this served to carry the concrete buggles used to deposit the concrete in place.

Templates of 2-inch by 2-inch angle-iron bent to the invert radius of 15 feet $4\frac{1}{2}$ inches, were placed at $12\frac{1}{2}$ -foot centers, with their ends set exactly at grade and wedged securely against the wall. These templates were moved ahead as the work progressed.

As in the placing of sides and arch, the aggregate for invert concrete was hauled to the work dry in trains of seven three-compartment cars, each compartment holding one three-sack batch. The cars were run up over the portable conveyor belt onto which their contents were discharged in separate piles and fed from the belt, one batch at a time, into the mixer and thoroughly mixed. The concrete, mixed as dry as it could be properly worked, was wheeled in buggies along the runway to the point of placing and dumped on the bottom. When sufficient concrete had been placed to fill a $12\frac{1}{2}$ foot section, it was screeded to exact invert shape by working a 2-inch by 4-inch piece held longitudinally over two templates. Finishers following behind the screeding operation removed the templates and floated the concrete to a smooth surface. The work progressed toward the mixing plant, which was moved to a new location at the end of each day's placement of concrete.

Placing of concrete was done only on the day shift. A night crew handled all work preliminary to the following day's concreting, such as moving back the portable plant, removing track, cleaning the bottom, and diverting water past the location of the next day's run.

To prevent damage to the newly placed concrete by the water flowing along the bottom of the tunnel, when invert was being placed westerly in the downstream direction, as from Second Garrote to Priest, the tunnel water was held behind portable wooden dams three feet high, placed on the previously constructed concrete invert about 500 feet from the beginning of the day's work. These dams were securely braced and were calked to prevent any material leakage. An eight-inch pipe from the dam was laid past the day's pour, supported on short pieces of drill steel set in sockets cast in the side walls when they were poured. The flow amounted to about 800 gallons per minute. Any slight leakage passing the wooden dam was caught by a supplemental sack dam on the finished invert just ahead of the day's pour.

Water entering the tunnel in the section to be concreted during the day's run was carried off at Priest by loose rock drains, and at Big Creek

by 3-inch open tile drains laid along the sides ahead of the invert placing and covered with roofing paper. A few feet back of the end of day's run these drains led to the surface through one inch or two inch risers placed in the concrete, which were opened as soon as the concrete had set.

At Big Creek, where the invert work was carried on in an upstream direction, tight sack dams on the rock bottom intercepted the water, which was then pumped through a pipe over the concrete being placed and released to flow out over the finished bottom.

Placing of invert lining from the Big Creek plant was begun October 10, 1924, working westerly from near Adit 6-7 toward Big Creek. An average progress of 350 feet per day was being made when the work was stopped December 7, 1924, by the order of the Acting Mayor, previously mentioned. After a delay of two weeks the work was resumed and was completed to Big Creek on December 31, 1924. Invert lining placed from Big Creek camp advancing east from Second Garrote begun January 8, 1925, was completed to Big Creek on February 19.

Invert lining placed from Priest Camp advancing west from Second Garrote shaft begun October 25, 1924, was also affected by the stop order of the Acting Mayor when a rate of progress of 260 feet per day was being made. This lining was finished on January 25, 1925. Ninety-five feet of sides and arch and 179 feet of invert were placed from Second Garrote shaft after which the shaft was closed as described below.

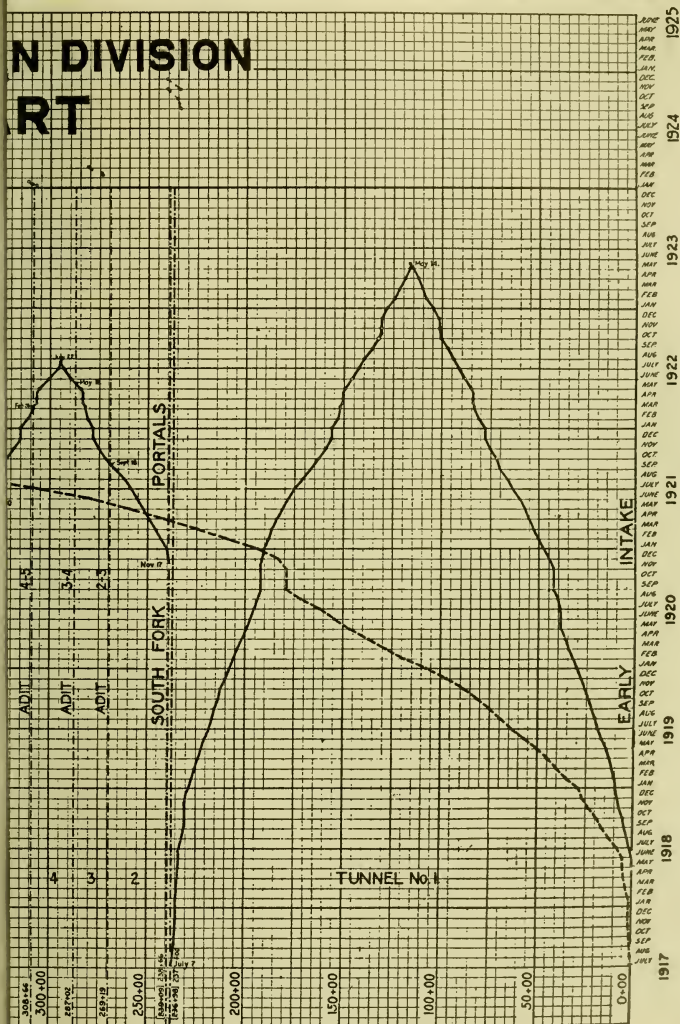
On June 1, 1925, an outfall structure at Priest Portal consisting of a parapet wall and wing walls, with concrete pavement between the wing walls, was finished and the first water was passed through the tunnel from Early Intake on June 2, 1925.

During the fiscal year there were placed from the Big Creek shaft plant 9,557 lineal feet of sides and arch and 37,696 lineal feet of invert, involving approximately 25,376 cubic yards of concrete; from Priest Portal plant there were placed 9,359 lineal feet of sides and arch and 20,492 lineal feet of invert, involving about 20,810 cubic yards of concrete.

The following table shows the quantities of concrete lining in the Mountain Division Tunnel:

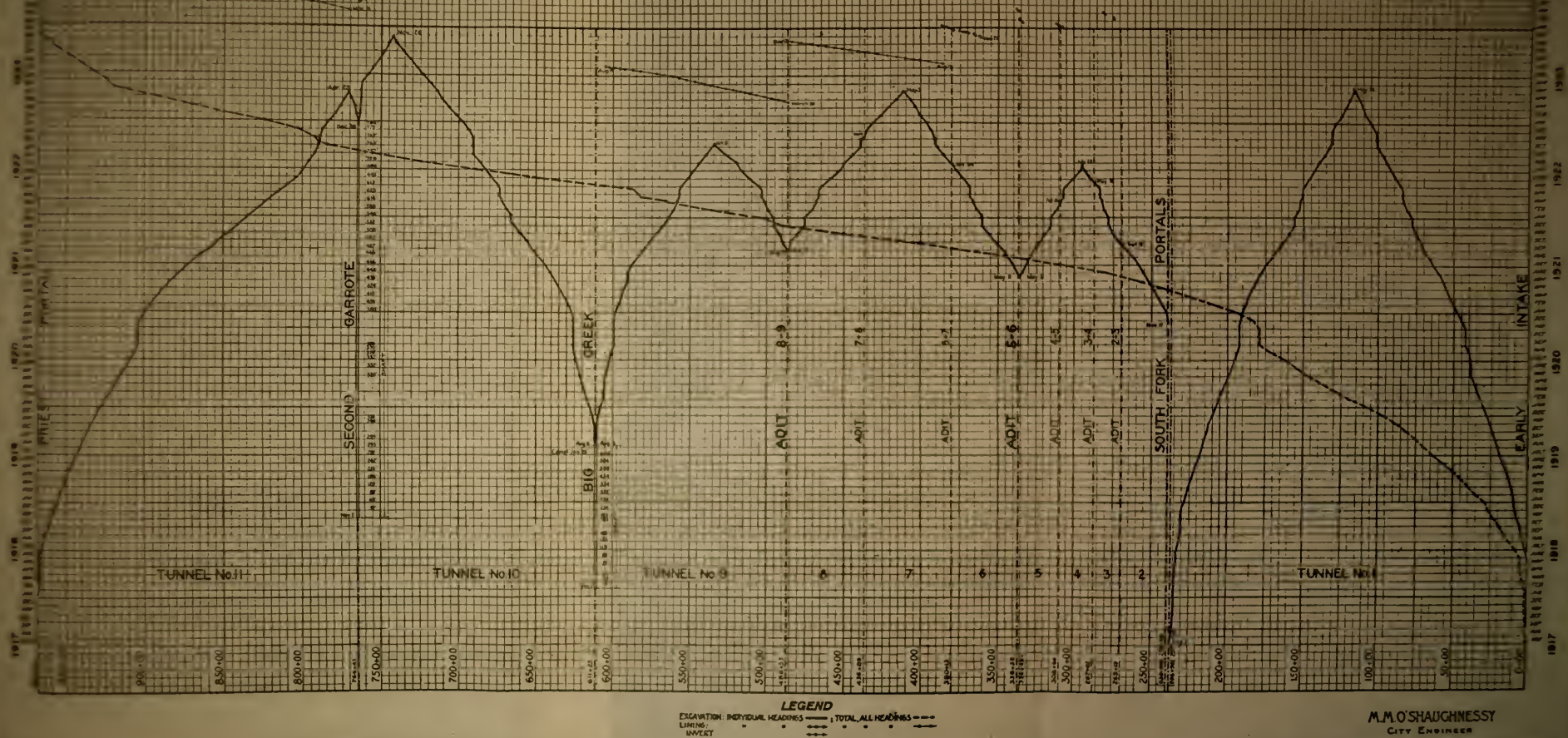
	Sides and Arch			Invert		
	Lin. ft.	Cu. Yds.	Cu. Yds. per ft.	Lin. ft.	Cu. Yds.	Cu. Yds. per ft.
Between Early Intake and South Fork, total of several short sections — hand placed	864	3,191.4	3.69	389	199.2	0.51
South Fork to Adit 6-7: Total of sev- eral short sections..	2,281	7,137.3	3.13	494	184.3	0.37
Adit 6-7 to Priest, continuous lining....	58,304	99,749.1	1.71	58,304	14,680.8	0.24
	<u>61,449</u>	<u>110,077.8</u>	<u>1.79</u>	<u>59,187</u>	<u>15,064.3</u>	<u>0.25</u>

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M.M.O'SHAUGHNESSY
CITY ENGINEER

HETCH HETCHY AQUEDUCT - MOUNTAIN DIVISION TUNNEL PROGRESS CHART



M.M.O'SHAUGHNESSY
CITY ENGINEER

Closing of Adits:

All adits have been closed with concrete plugs, with manholes provided for entrance to the tunnel. At Early Intake, Adit 5-6 and Adit 8-9, the manholes are five feet in diameter to allow the passage of a small car if necessary to transport materials into the tunnel for repairs. Sand traps and 12-inch blow-offs were also provided. At Adits 2-3, 3-4, 4-5, 6-7 and 7-8 the manholes in the concrete plugs are thirty inches in diameter. Concrete lining was constructed in some of the adits, between their portals and the concrete plugs, to prevent caving. In Adit 4-5, a length of 22 feet was lined; in Adit 5-6, 15 feet; in Adit 6-7, 24 feet; in Adit 8-9, 204 feet. In these four adits, concrete portal structures were constructed. The portals of all adits are closed by heavy doors.

Closing of Shafts:

At Big Creek shaft, after backfilling the rock pocket and sump below the tunnel level, the final section of tunnel lining was poured May 12, 1925. A three foot diameter opening was left, from which a concrete pipe leads up through the shaft to the surface, providing a permanent passageway for access from the surface through the shaft to the tunnel. Thirteen hundred feet of pipe of 3 feet inside diameter and 5 inches thickness, in two foot lengths, was previously cast at Big Creek for use in the two shafts. The pipe was set in the center compartment of the shaft as the backfill proceeded. The backfill consisted of a lean concrete of one sack of cement to one cubic yard of "run of mine" material taken from the tunnel dump and screened to three-inch size. Before backfilling each section of shaft, the lagging and blocking back of the sets to be covered in the day's run were removed but the timbers were left. The work was completed on June 30, 1925.

At Second Garrote shaft the procedure was similar. The backfilling of this shaft was done at the average rate of 22 feet per day, a total volume of 3248 cubic yards of lean mix concrete being placed. This work was finished May 12, 1925. The pump and pipe installed at this shaft for the Groveland water supply have already been mentioned.

Upon the completion of the tunnel work all camps were removed and the sites were cleaned.

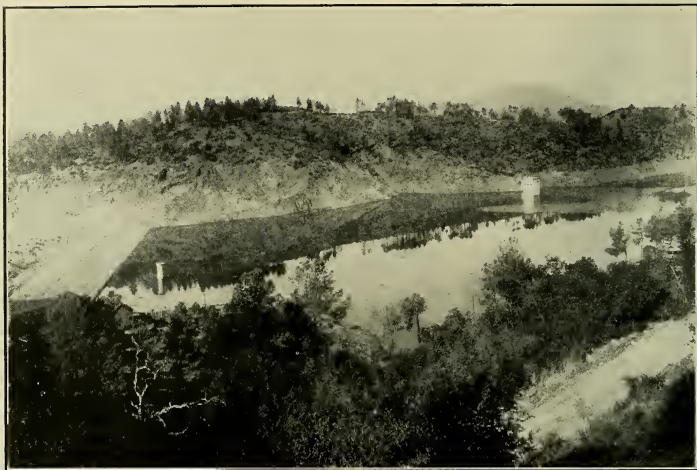
Moccasin Division

The Moccasin Division, as generally referred to, includes the Priest dam and reservoir, the power tunnel and headworks, the surge shaft, the penstocks and power plant. The transmission line while geographically almost wholly without this division is included for administrative purposes.

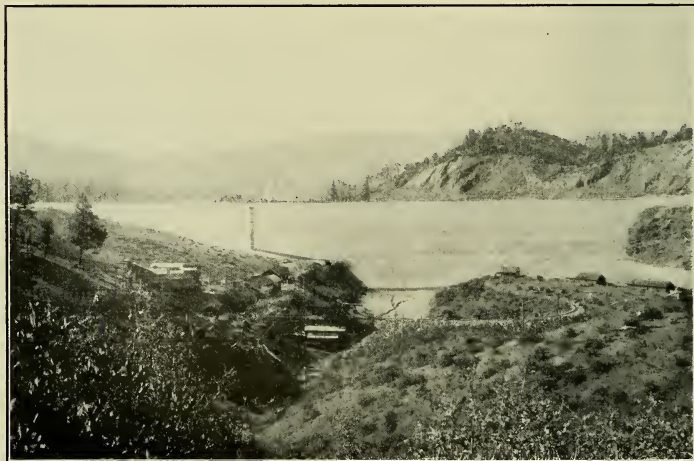
The Priest dam and its construction was fully described in the previous annual report of this department.

Power Tunnel Headworks:

Water for the Moccasin plant (whence it will ultimately continue to San Francisco) passes from Priest reservoir into the power tunnel through a gate tower, where provision is also made for the removal of trash by screen racks.



Reservoir capacity 800 million gallons; high water line at elevation 2240. Mountain Division aqueduct tunnel discharges near house (right center). Gatehouse (upper right) at entrance to power tunnel, 95 feet below high water.



View down Rattlesnake Creek showing upstream face of Priest Dam. Dam is 145 feet high; crest elevation 2245.

PRIEST DAM AND REGULATING RESERVOIR, MOCCASIN POWER DEVELOPMENT, H. H. W. S.

The gate and screen operating chamber of the tower or headworks for power tunnel is reached from the shore over a foot bridge consisting of three 60-foot spans of light steel on concrete piers. The tower proper is elliptical in plan, 65 feet long by 36 feet wide. A semicircular concrete screen rack with precast screens projects 18 feet from the body of the main structure. This screen rack extends from elevation 2145 to elevation 2216.6 and is of the same general design as the screen racks at the O'Shaughnessy dam. The height of the tower from the tunnel invert to operating floor is 100 feet and above this level is a reinforced concrete structure 34 feet by 34 feet 6 inches by 24 feet 4 inches high, housing the mechanical apparatus for operating the gates and screens.

Six sluice gates, each 6 feet by 8 feet, operated by a 50 horsepower motor, afford emergency control for shutting off the flow of water through the tunnel. A gasoline engine drive is provided as auxiliary for the operation of the gates in event of failure of electric power supply. Provision is also made for manual operation.

Inside screens of the "grizzly" type, with openings narrower than those in the outer concrete screen rack, are installed in compartments immediately in front of the gates and provided with a system of manually operated scraper buckets attached to roller chains by which they can be dragged along the face of the bars to remove the trash.

The intake structure contains 2765 cubic yards of concrete and 259 tons of reinforcing steel. Excavation for the foundation was begun in January, 1925. The main structure was ready for operation in May and the roof of the house was completed on June 30. Excellent progress on this structure is due to Foreman "Pat" Keenan.

Power Tunnel:

The excavation of the tunnel was completed in 1923 as described in previous reports. The concrete lining of the power tunnel from the headworks structure to the surge shaft was begun July 21, 1924, at a point near the middle of the tunnel, and was continued westerly to the surge shaft, which was reached on October 4. The concrete placing outfit was then reversed, and, beginning at the central point, the concrete lining was continued in an easterly direction toward Priest Reservoir, the work being completed on January 9, 1925.

For placing this concrete a 30-inch Webb concrete gun and a 21-S Ransome concrete mixer were used. Aggregate for the westerly half of the tunnel was brought in from West Portal; for the easterly half from Priest Portal.

After thoroughly cleaning the tunnel bottom, work was begun on the placing of the tunnel invert on January 24 and completed March 5.

Following the completion of the lining of sides, arch and invert, the voids back of the lining were filled with a 1 to 5 grout through 2 inch pipes which had been set at intervals of 5 feet in the timbered section and 10 feet in the untimbered section. The grout was forced in at a pressure of 60 pounds per square inch by the same concrete guns that had been used in placing the concrete lining. The sand used was very

fine, consisting of the tailings from the cyanide plant of an abandoned gold mine in the vicinity. The work of grouting was completed April 21, 1925.

The following tabulation gives the quantities of concrete and grout in this tunnel:

	Lin. ft.	Cu. Yds., Total	Cu. Yds. per ft.
Sides and arch.....	5335	15,950.3	2.99
Invert	5333	2,671.8	.50
Grout	5335	2,442	.46
<hr/>			
Total	5335	21,064.1	3.95

Surge Shaft:

The excavation of the surge shaft had been completed in December, 1923. The concrete work commenced December 10, 1924, was completed May 2, 1925.

The shaft is circular in form, 40 feet in inside diameter, the upper rim being at elevation 2272, or 160 feet above tunnel floor, 112 feet of this height being below the ground surface and 48 feet above. Below ground surface the concrete walls have a minimum thickness of 24 inches, above the ground the thickness varies from 24 inches to 10 inches at the top. The bottom of the shaft is 18 inches thick and heavily reinforced. The structure contains 2185 cubic yards of 1:2:4 concrete with 211 tons of reinforcing steel.

For a few feet of height just above the ground, the maximum reinforcement in the walls is exceptionally heavy, consisting of two rings (inner and outer) of 1 $\frac{1}{4}$ inch square bars staggered at 7 inch centers. Above this point the reinforcement becomes lighter in proportion to the water pressure. Below ground surface the reinforcement is again made lighter as the concrete is supported by the surrounding rock. The timbering was all removed as the concrete was placed.

Provision for expansion and contraction, due to water pressure and temperature changes, was made by introduction of two horizontal joints in the cylindrical concrete walls—one approximately at the ground surface and one at the line of demarcation between the solid rock and the earth overburden. These joints were troweled smooth and made water tight by an asphaltic mixture poured hot into a groove extending along each joint inside the shaft, which groove had been calked with oakum. Accumulation of external water pressure is prevented by a system of porous cement drain tile just outside the concrete walls and beneath the floor, which connects with a pipe laid under the bottom of the floor of the central penstock tunnel which discharges at the portal.

The concrete work of the surge chamber was in charge of Superintendent Ed. Haskell, associated with W. A. Kramer, contractor on the penstock installation, and was handled in excellent manner.

Penstock Tunnel:

The surge shaft serves as a manifold from which the penstocks lead



PENSTOCKS, MOCCASIN POWER PLANT, HETCH HETCHY WATER SUPPLY.

104 inch diameter pipes at west end of power tunnel. Surge shaft (in upper center), 40 feet inside diameter, where tunnel divides and pipes begin. At right is shown connection for a third 104 inch pipe to be constructed in future, when Moccasin Power Plant is enlarged.

to the power house. From the surge chamber to the ground surface, a distance of 535 feet, the three pipes are laid in parallel tunnels, 25 feet apart on centers. The inlet to each pipe at the surge shaft is the frustum of a cone reducing from 12 feet 4 inches to 8 feet 8 inches diameter. The pipes in the tunnels were laid two lengths (about 50 feet) at a time, riveted and calked. The space between the pipe and the tunnel walls was filled with concrete, prior to placing of which the pipe was thoroughly braced to prevent deformation or movement. The concrete was placed by means of a Webb concrete gun set up at the portals, mounted on a traveler or "jumbo," which ran on a short track at right angles to the center line of tunnel outside of and close to the portals. This gun could

be shifted from tunnel to tunnel with a loss of but a few minutes. 6105 cubic yards of concrete were placed in this manner, the work being completed April 1, 1925.

Grouting operations to fill the voids between the rock and the top of concrete began at a point about 20 feet from the surge chamber in each tunnel. Grout pipes were placed in all the large holes in each tunnel and carried out to a point at which it was determined no grout was necessary. From the initial point back to the surge chamber the grouting was done from pipes leading to the surge chamber. The end of each pipe was tagged with a number to indicate the order in which grout was to be forced into the pipes. 361 cubic yards of grout were so poured.

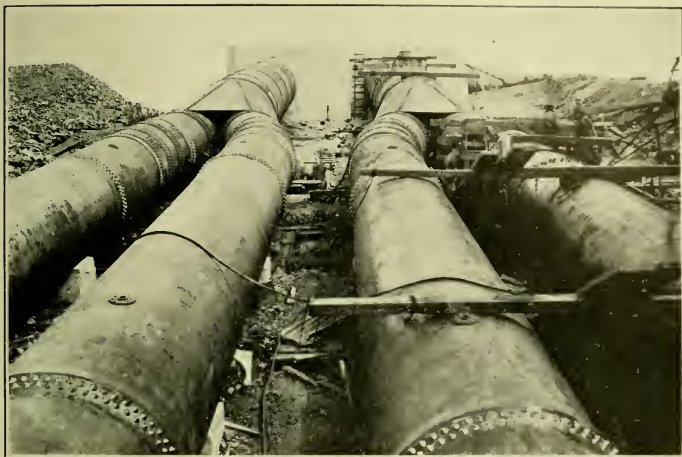
Butterfly Valves:

A 104-inch diameter butterfly valve is installed in each line approximately 50 feet west from the portal. The most southerly pipe is temporarily dead-ended by a blind flange pending the installation of two additional units at the power house.

These butterfly valves are motor operated and provided with remote control for closure from the power house, some 5000 feet distant. As a precautionary measure the valves can only be opened by a control at the valve. They can be operated from closed to fully open position, or vice versa, in three minutes. Under a test pressure of 90 pounds per square inch the leakage passing the valve disc was 5 gallons per minute. The valves were made by a San Francisco concern—Joshua Hendy Iron Works.

Penstock Pipes:

The two penstock pipes extending from the butterfly valves down the hill are fitted each with two sets of eight 8-inch air valves to allow ingress of air and prevent collapse should the water be drawn too rapidly from the lower end of the pipes. The plate thickness is $\frac{3}{8}$ inch in the tunnels and $\frac{1}{16}$ inch at the valves. At elevation 2070 the diameter is 98 inches and the thickness $\frac{1}{2}$ inch. At elevation 2060 the longitudinal seams change from double-riveted lap to triple-riveted butt-strap. At elevation 1950 the two 98-inch pipes branch each into two pipes of 66-inch diameter. The pipes down to this point, a slope distance of 2111 feet, were made by the Western Pipe and Steel Company of San Francisco; from the Y branches to the power house, a slope distance of 3469 feet, by the M. W. Kellogg Company of Jersey City, New Jersey. This lower portion of the pipe is hammer-forge welded with the riveted circumferential joints of the "bumped" type, in which the obstruction of the rivet heads to stream flow is reduced. These pipes range from 66 inch diameter, $\frac{7}{16}$ to $\frac{3}{8}$ inch thick, through 60 inches diameter, $\frac{5}{8}$ to 1 inch thick, and 57 inches diameter, $\frac{1}{4}$ to $1\frac{3}{16}$ inches thick, to 54 inches diameter, $1\frac{1}{8}$ to $1\frac{5}{16}$ inches thick. Just outside of the power house the four 54-inch lines branch each into two 36-inch lines, one for each water wheel runner. In each of these lines a 36-inch hydraulic-operated gate valve is installed, located in an arcade of the main building. The total weight of the penstock pipe is 6276.19 tons.



PENSTOCKS, MOCCASIN POWER PLANT, H. H. W. S.
Showing connection from two 98-inch riveted pipes to four 66-inch welded pipes.

For a distance of 500 feet from the power house the pipes were laid in trench, the 270 feet next to the building being imbedded in concrete with a minimum thickness of 12 inches of concrete over the pipe.

The pipe line is supported on concrete piers throughout, the spacing being approximately 30 feet corresponding to the length of pipe section. The height of piers from bottom varies from $4\frac{1}{2}$ feet to 9 feet, the width at top being 2 feet; the downhill face of each pier is vertical and the uphill face normal to the pipe. Five hundred and thirty-three saddles were built containing 1202 cubic yards of concrete. Movement of the pipes on these piers due to temperature change is provided for. At each vertical or horizontal angle in the penstocks, massive reinforced concrete anchors are provided. These are 18 in number and the largest of these contains 839 cubic yards of concrete and 7.64 tons of reinforcing steel. The total concrete in anchors is 7298 cubic yards. At the Y branch, a special sliding anchor was introduced in which the upper portion inclosing the pipe is allowed to slide on cast iron plates imbedded in the fixed concrete of the lower portion. Expansion joints are installed between each pair of concrete anchors.

The protection coating used on the pipe was Biturine enamel applied as a hot brush coat approximately $\frac{1}{16}$ inch thick over a Biturine priming solution.

Transportation along the line of pipes during construction was by inclined tramway, with $1\frac{1}{4}$ -inch diameter steel cable of 25 tons capacity

on the steepest grade, operated by a 250 horsepower motor near the tunnel outlets at West Portal.

Pipe laying began at the valves at the power house March 1, 1924. On account of the intense heat of the pipes during the summer months the working day began at 4:00 A. M. and ended at noon. Pipe laying was completed on March 16, 1925, except for the butterfly valves which were placed ready for operation in May, upon the completion of the tunnel connection. The entire line was ready for use June 1, 1925.

All of the construction from Priest dam to Moccasin power plant has been done by day labor under the direction of the City Engineer.

The following table summarizes quantities involved in the penstock installation, including the surge chamber and the outlet tunnels containing the upper portion of the penstocks:

	Excavation Cu. Yds.	Concrete Cu. Yds.	Reinforcing Steel Tons	Penstock Pipe Tons
Penstocks	49,575	.....	.....	.....
Anchors	6,643	7,298	73.24	.....
Saddles	1,801	1,202	1.05	.....
Joint holes.....	1,646	.....	.....	.....
Surge chamber.....	5,896*	2,185	211.02	.....
Outlet tunnels.....	9,703*	6,105	.....	.....
Butterfly valve foundations.....	.....	59	5.15	.....
Retaining wall at tunnel portals .....	.....	57	8.	.....
Welded pipe.....	.....	.....	.....	4,692.40
Riveted pipe.....	.....	.....	.....	1,583.79
	75,264	16,906	298.46	6,276.19
Grouting, Surge tank and Outlet tunnels, cu. yds.....				361.0
4 inch Drain tile, Surge tank and Outlet tunnels, lin. ft.....				891.0
6 inch Drain tile, Surge tank and Outlet tunnels, lin. ft.....				779.0
Number of anchors.....				18
Number of saddles.....				533

*Excavation quantities indicated are to neat lines only, not including overbreak.

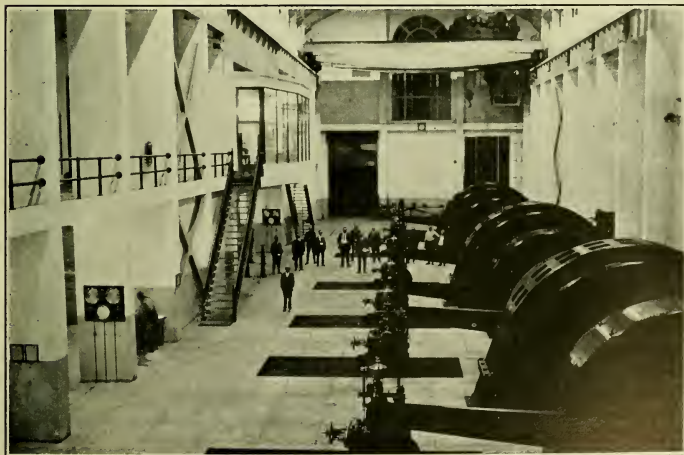
Power House Building:

The power house building is a steel frame structure with massive concrete foundations and reinforced concrete walls and roof. The building is 98 feet in width and its present length is 225 feet. One end of the building is so constructed that an extension may be readily made to house two additional generators. The height is 67 feet above the main floor with a 15 foot basement below.

The architecture is distinctly of the Mission style which has been well carried out and adapted to the purpose. The roof is covered with red tile, and arcades on either side of the building serve on the one hand



Exterior view, north and west elevations, showing tailrace canal.



Interior view showing three of the four 25,000 h.p. generating units.
MOCCASIN POWER HOUSE, HETCH HETCHY WATER SUPPLY.

to house the 36 inch hydraulically operated gate valves and on the other hand to shelter the grilles in the floor which admit cooling air to the generator pits. This arrangement of air intake and baffle plates permitted the lowering of the power house floor sufficiently to provide enough additional power to more than pay interest on any slight additional cost of construction.

Water Wheels:

The water wheels are of the double overhung impulse type, the single runners being rated at 12,500 h.p. (25,000 h.p. generating unit) for maximum efficiency with an overload capacity of 10%.

Two governors are provided for each generator unit, one for each runner, and speed regulation is maintained by means of needle nozzles, each of which is fitted with an auxiliary nozzle which may be operated either as a water saving or synchronous by pass. Each main unit has its individual oil pressure set supplying oil under 150 pounds pressure to actuate the governors, although each has capacity to handle two generator units.

The following features make for simplicity of operation: the speed can be raised or lowered from the switchboard; the amount of load on any generator can be limited from the switchboard; and units can be completely shut down from the switchboard. Special mechanical arrangements permit shifting from hand control to automatic control by moving only one lever. A further refinement causes both the automatic and hand control mechanism to be synchronized so that the change from one form of control to the other can take place without hunting action of the governor or change in waterwheel speed. Large yellow enameled indicators actuated by the governors permit the operator to observe the position of the needle nozzle from the switchboard gallery. The pits around the governor mechanisms are covered with Irving subway grating, thus making the action of the servometer visible from the operating floor. This construction also admits daylight and air into the pits. The nozzle mechanism and generator pits are also readily accessible from the basement.

The Pelton Water Wheel Company supplied the water wheels, governors and their auxiliaries.

Generators:

The generators are each of 20,000 kv-a capacity generating at 11,000 volts, 257 r. p. m. The generator rotor is mounted on the shaft between the two water wheel runners. Two cast steel flywheel elements, machined to receive the poles, form the spider. A sheet steel housing causes air to be taken from the arcade outside the building through the pit under the generator and to be forced through the windings and the stator frame into the generator room. Each unit requires 60,000 cubic feet of air per minute under full load conditions. A monitor and louvres in the roof provide ample outlet for the heated air from the generator room.

As indicative of the rate at which waterwheels and generators are increasing in size, it is interesting to note that when this project was first studied, units of 12,500 kv-a capacity were the largest obtainable. However, when the time came actually to place the order for the machines, 20,000 kv-a units were readily to be had.

One unit of this size has capacity for charging an unloaded transmission line, the line requiring approximately 17,000 kv-a at 150 kv. The characteristics of the generators are such as to prevent their being self-exciting when carrying this load. This makes it possible to put a single generator on a transmission line and gradually build up the voltage without exceeding the desired voltage at the delivery end of the line.

The generators were furnished by the General Electric Company.

Transformers:

The transformer installation consists of 4 banks of three 6667-kv-a single phase units and one spare. The voltage rating of the transformers permits of stepping 11 kv. delta to either 115 or 154 "Y" with taps for voltage increases up to 5% on the high side. They are of the oil insulated, water-cooled type, fitted with cooling water and temperature alarms which register on the switchboard. Each transformer is fitted with pipe connections for draining, filling and filtering the oil.

Cooling water is pumped from the tail race rather than use the water from the penstocks, effecting an economy in power production of 60 kilowatts under full load conditions.

The transformers were furnished by the Westinghouse Electric and Manufacturing Company.

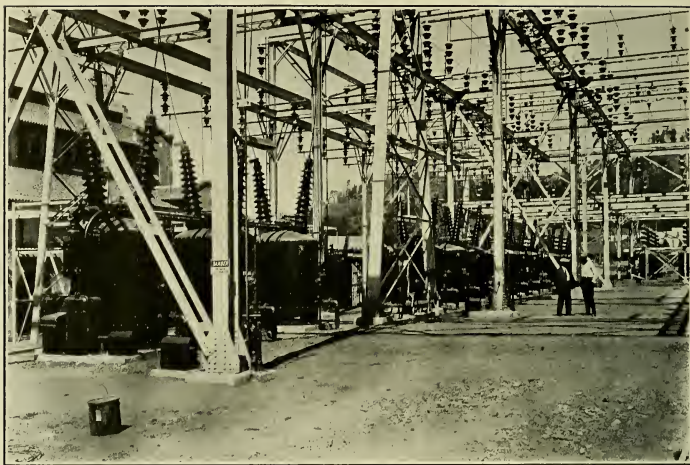
Regulators and Switchboards:

The generators are controlled from the switchboard located at one side of the center of the building. The design of the plant contemplates that a generator with its associated bank of transformers will be operated as a unit. Units will be connected only on the high side of the transformers. This arrangement does away with a complicated system of 11-kv. switches and busses and materially simplifies the whole power house layout. To provide the station power requirements, supply two local 11-kv. feeders and, in emergency, permit any generator to be connected to any bank of transformers, one 11-kv. bus has been run the full length of the power house. Normally this will be connected to but one generator at a time.

A Westinghouse broadrange type of regulator is provided for the exciter of each generator, and for a spare motor generator exciter which has sufficient capacity to supply excitation to two generators. Field control boards for all units have been placed on the main floor adjacent to the exciters.

Switching Apparatus:

Owing to the almost ideal topography at the power house site, it



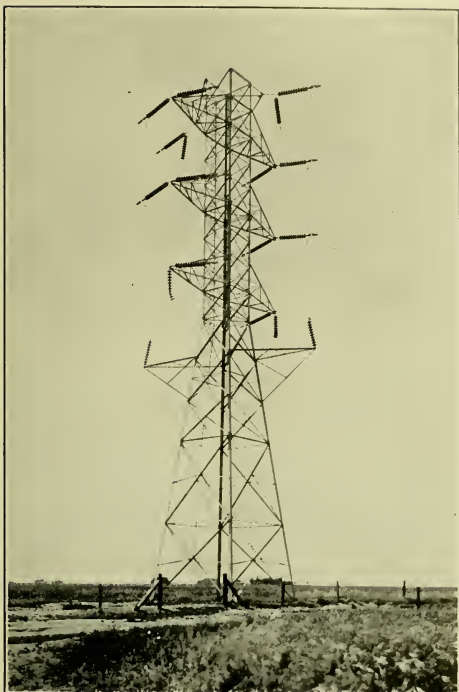
MOCASIN POWER PLANT, HETCH HETCHY WATER SUPPLY
Outdoor Bus Bar Structure and Switchyard

was possible to conveniently install all of the transformers, high-voltage switches and busses outside the power house. The 11-kv. leads from the generator switches are carried overhead on a steel structure from the building to the low-voltage bushings on the transformers. From the high-voltage bushings the power may be connected to either of two high-voltage busses.

These high-voltage busses connecting the transformers to transmission lines are of 750,000 circ. mil. stranded copper. High-voltage connections for individual units are made of standard $2\frac{1}{2}$ inch wrought iron pipe. Connections for the transmission lines are made of $21\frac{1}{2}$ inch extra heavy pipe. As far as possible, air-break switches were substituted for high-voltage oil switches, at an appreciable saving in cost. This necessitated a very careful arrangement of interlocks between switches and, as a further precaution, a very complete arrangement of semaphore signals and light signals has been installed to prevent the incorrect operation of a switch by hand. All of the air-break switches, with the exception of the bus sectionalizing switch, are power-operated direct from the switchboard. A lookout window in the rear of the power house, readily accessible from the switchboard room, permits the operator to overlook the switch yard and penstocks.

Transmission Lines:

Two transmission lines leading toward San Francisco connect to the high-voltage busses at the present time. In the future, power from the



TRANSPPOSITION TOWER, MOCCASIN-SAN FRANCISCO ELECTRIC POWER TRANSMISSION LINE, H. H. W. S.

upper plants will be transmitted over two other lines into the same busses, at which time the number of transmission lines from Moccasin to the Bay region will have been increased to four, making a total of six lines handled by the Moccasin busses.

The two lines at present installed are carried on five hundred and six double circuit, galvanized steel towers, 98 feet in height, over the 98½-mile stretch between Moccasin and the Pacific Gas and Electric sub-station at Newark. The route crosses the San Joaquin Valley going due west, three miles north of Modesto. The right of way is 110 feet in width, the first line of towers being constructed within 20 feet of the north side thereof. The lowest crossarm is 62 feet above ground level. Conductors of each circuit are spaced 15 feet apart vertically. The horizontal distance between the wires at the top and bottom crossarms on

the tower is 24 feet and at the middle arm 28 feet. Average spacing between towers in level country is 950 feet while the spacing in the rougher country varies from 350 to 2212 feet. No very cold weather is experienced and the line has been strung for a maximum tension of 5,000 pounds at 20 degrees (F.), with a side wind pressure of 8 pounds per foot. This results in a normal tension of from 3,000 to 3,700 pounds in the line under average temperature and wind conditions.

On that portion of the line at a distance from the salt fogs of San Francisco Bay, a 397,500 cir. mil. steel-reinforced, aluminum cable supplied by the Aluminum Company of America has been installed. In the vicinity of the Bay, nine miles of line are strung with conductors of stranded copper with hemp core having a copper cross-section of 345,000 circ. mils. This gives a conductor of $\frac{3}{4}$ inch external diameter, which is necessary in order to prevent excessive corona loss when operating at 154 kv. This conductor was supplied by the Anaconda Copper Mining Company.

Four types of transmission towers are used in the line. These are classified as follows: standard towers, for normal conditions of stress and spacing; heavy duty towers, for angles, points of heavy pull and railroad crossings; switch towers, for accommodating air-break line sectionalizing switches; and transposition towers. Towers are of galvanized steel and were supplied by the Pacific Coast Steel Company.

On standard towers, suspension insulation consists of 10 Westinghouse No. 601 units. On heavy duty towers at dead ends 12 Westinghouse No. 631 units are used and on heavy duty suspension strings, 10 of the same insulators. As far as possible dead-end construction was avoided.

No telephone line has been built in connection with the transmission circuits. It is the intention to use a carrier current system for communication between the generating and receiving points.

Tests and Operation:

On Sunday, June 7, 1925, the first water diverted from the Tuolumne River at Early Intake, flowed over the sill of the Moccasin power tunnel inlet, down the penstocks and through the nozzles at the power house. After flushing the penstocks thoroughly, the valves were closed and the pressure allowed to build up, permitting of the first unit being turned over for the purpose of drying out the windings on June 8, 1925. The next unit was turned over on June 13, 1925, the third on June 22, and the fourth on June 23.

During this period of drying out, adjustments of the governors and nozzles were made and tests of the insulation resistance of the machines were made at frequent intervals, and on June 23, 1925, it was possible to bring the No. 2 unit up to full 11,000 volts and with this voltage, test out all of the other apparatus in the power house and the transmission lines to Newark. Unit No. 1 was brought to full voltage shortly thereafter, while units Nos. 3 and 4 were approximately dry and ready for operation at full voltage on June 30.

On that date, due to improper handling of one of the 36 inch gate valves controlling the No. 3 unit when a power house employee opened the main valve without opening the by pass, a pressure surge was set up in the No. 3 penstock which was communicated to the No. 4 penstock, bursting a section of that pipe at a point of defective weld. (Investigation disclosed that in an 11/16 inch designed thickness there was $\frac{1}{2}$ inch of defective welding.) A few minutes later a section of pipe in the No. 1 line let go likewise at a point of defective weld. These breaks resulted in flooding the power house basement with mud and water, which entered the generator pits. Iron shutters have since been installed in the power house to prevent damage from a future recurrence.

Considerable delay ensued in placing the plant in service due to the necessity of cleaning out the mud and again drying out the generators, so that it was not until August 14 that the actual delivery of power was begun under the contract with the Pacific Gas and Electric Company for distributing the same, although that company had completed its connections and was in a position to accept delivery at Newark on July 20, 1925.

Lower Cherry River Power System

The Early Intake plant of the Cherry River power development has been continuously in action during the last year without particular incident. During the year the amount of energy required for the construction work being carried on by the City was materially reduced as various portions of the work were finally completed. The following table gives details as to the amount of energy generated and the disposal made of it.

Statistics of Operation of Lower Cherry Power System (July 1924 to June 1925, inclusive)

Power Generated and Received:	Kilowatt-hrs.
Generated at Lower Cherry Plant.....	21,404,300
Metered in from P. G. & E. Co., Priest.....	18,000
Metered in from P. G. & E. Co., Moccasin	522,000
Total	21,944,300
Disposal of Power:	
Used by City.....	5,283,576
Metered out to P. G. & E. Co., Priest.....	11,493,000
Metered out to miscellaneous consumers.....	3,463
Transmission losses and unaccounted for.....	5,164,261
Total	21,944,300

The Lower Cherry aqueduct was extended to discharge above the Early Intake diversion dam so that the flow of the Cherry River could pass through the tunnel to the Moccasin plant. When the Moccasin plant is placed in operation the Lower Cherry construction power plant

will not be operated except when and to such extent as there is available water in excess of the full requirements of the Moccasin plant. The reason for this is that a unit of water passed through the Moccasin plant will produce 3.6 times as many units of energy as through the Lower Cherry plant.

Power Disposal

The question of disposal of the output of the Moccasin plant has been under consideration for a considerable period of time. Reports on this subject were rendered to the Board of Supervisors on April 4, 1923, and September 11, 1923. (See annual report of Bureau of Engineering 1922-23.) The recommendations made in the latter report are quoted below:

"As between the construction of an independent distributing system and the acquisition of the existing distributing system, there can be, I believe, no argument in favor of constructing an independent system in a competitive field, as against the acquisition of the existing systems, with their developed markets. An independent system should be considered as a last resort in the event that the existing systems could not be acquired, either by negotiation or condemnation proceedings within a reasonable period of time, during which our power plant was not producing revenue.

"Under the charter we are committed to the ultimate ownership of our public utilities. There is no question in my mind, nor, I believe, in the minds of any of your Board, but that San Francisco should eventually own and operate her own distributing system for her own electric power. Further there is no question that whatever figure the power companies might name for the disposal of their existing distributing systems, it would be necessary for independent valuations to be made of these properties. The Railroad Commission of the State of California is best qualified to make such valuation and the public generally would have the greatest confidence in the fairness of a valuation made by this Board. Therefore, as a step which will minimize the delay in whatever plan your Board may adopt, I would recommend that your Board take the necessary action and immediately instruct the City Attorney to bring suit in eminent domain for the acquisition of the entire portions of the distributing systems of both the Pacific Gas & Electric Company and the Great Western Power Company, necessary for serving all of San Francisco.

"Under this procedure the Railroad Commission will make a valuation of these properties. A suit should then be filed in the Superior Court setting up this valuation and asking for a decree in condemnation entitling the City to take possession of the properties upon payment of this price. When such a decree has been obtained an election should be held to vote the bonds necessary to acquire the properties. The bonds should be sold and the price tendered or paid into the court.

"It is my opinion that if San Francisco distribute the output of

the Moccasin Creek power plant directly to the consumers we should take over the entire distribution within the City and purchase temporarily such additional power as may be needed in order that all districts may share in whatever benefits may be derived. This would also avoid complications of division of ownership and authority in any parts of the existing systems which otherwise might be required for common use between private companies and the City. This condition would of necessity exist on account of the different districts being inter-connected for service from the distributing center.

"Should your Board institute condemnation proceedings for these properties it would, of course, be impossible for any one to state with any degree of authority the length of time necessary to acquire possession of the same. The time required would depend largely on the attitude of the power companies in either facilitating or attempting to delay proceedings. I understand that it took Los Angeles over five years to effect possession; in Marin County it took between two and three years to acquire the existing water system.

"Notwithstanding the efforts of the City Attorney to hasten the pending gas rate litigation involving valuation of gas properties in San Francisco, over six years have been consumed in trial and appeal. Should it appear that possession of the distributing systems cannot be obtained for some considerable period after completion of the Moccasin Creek plant, I would recommend, pending securing such possession, that your Board arrange for the marketing of the power either through the agency of the existing companies in San Francisco or in any other possible way which can be arranged.

"Any such arrangement should terminate automatically upon securing possession of the properties and should be so drawn as to conform with all legal requirements.

"Failure to provide for such temporary disposal of the Moccasin Creek power output when the plant is ready for operation will, on the basis of the offers made by the power companies, subject the taxpayers of San Francisco to an annual loss of not less than \$2,000,000."

On the day that this report was delivered to the Board of Supervisors that body passed Resolution No. 21,558, directing "that negotiations for the purchase by the City, and within the City limits, of a distribution system from an existing private corporation, and preferably the Pacific Gas & Electric Company, be placed in the hands of an advisory committee of five citizens to be appointed by the Mayor; and that said advisory committee be respectfully requested to proceed at once and to report within thirty days its progress and recommendations." This resolution further directed the City Engineer to prepare plans and specifications for a complete municipal distribution system capable of supplying the householders and industries of San Francisco with electric light and power.

The Mayor appointed on this advisory committee, on September 17.

1923, the Honorable James D. Phelan, Chairman; Justice Matt I. Sullivan, Judge F. J. Murasky, Major Chas. H. Kendrick, and Henry F. Boyen. These gentlemen immediately went to work on the problem placed before them, calling on the City Engineer from time to time for data and information. This Committee addressed communications to the Pacific Gas & Electric Company and the Great Western Power Company requesting that they enter into negotiations for the sale of their distribution plants in San Francisco to the City. On October 2, 1923, both of these companies replied declining to negotiate for the sale of their property.

On October 8, 1923, the Board of Supervisors passed Ordinance No. 6,013 requiring that the Board of Public Works, in accordance with the provisions of the Charter, furnish the Board with plans, estimates and cost of original construction of:

- (1) A distribution and standby plant for distribution of the output of Moccasin Plant;
- (2) The existing distribution and standby plants used by the Great Western Power Company in supplying energy to San Francisco, showing separately the portion of their plant acquired from Universal Electric and Gas Company;
- (3) The existing distribution system and standby plants used by the Pacific Gas & Electric Company in supplying electric energy to the people of San Francisco.

On October 21, 1923, the Board of Supervisors passed resolutions directing the City Engineer to make surveys and determine the location for a high-voltage receiving station to be erected in San Francisco, and to furnish the City Attorney a description of the electric distribution property which should be acquired from the Great Western Power Company, and the same information applying to the system of the Pacific Gas & Electric Company. The data called for was to be prepared by the City Attorney for filing with the Railroad Commission of the State of California in the form of petitions, declaring that it was the intention of the City and County of San Francisco to submit to the citizens, under eminent domain proceedings, a proposition to purchase the properties described. This work was completed on January 21, 1924, the Board of Supervisors directed the City Attorney to file the petitions with the Railroad Commission of the State of California.

The City Engineer in the preparation of his report included with the distribution system of the Pacific Gas & Electric Company within the bounds of the City, the step-down station of that Company just outside of San Francisco, in San Mateo County, and the two high-tension transmission circuits connecting this step-down station with the Company's Newark substation on the east side of the Bay of San Francisco, near Irvington. On March 17, 1924, John J. Dailey, Assistant City Attorney, was appointed special attorney to take charge of the proceedings before the Railroad Commission proposed by the above ordinances, the sum of \$5,000 having been set aside to begin this work. On

March 28, 1924, the Railroad Commission issued orders directed to both companies to show cause why the Commission should not proceed with such valuation, and hearing was set for July 8, 1924. On June 20, 1924, the City Engineer submitted to the Board of Supervisors through the Board of Public Works, a complete report complying with the requirements of Ordinance No. 6,013. This report follows:

June 20, 1924.

To the Honorable
The Board of Public Works of the
City and County of San Francisco.
Gentlemen:

In accordance with Ordinance No. 6,013 (New Series), I submit herewith plans and estimates of the cost of original construction and completion as follows:

(1) Plans and estimates of the cost of original construction and completion of an electrical distributing system and standby plant sufficient for distributing in the City and County of San Francisco the electrical energy to be developed at the Moccasin Creek Power Plant of the Hetch Hetchy Project.

(2) Plans and estimates of the cost of original construction and completion of the existing distributing system and standby plants used by the Great Western Power Company in supplying electrical energy within San Francisco, including easements and other properties and rights owned in San Francisco and used or useful in connection with said system, showing separately estimates of cost of original construction and completion of the portion of the plant acquired from the Universal Electrical and Gas Company.

(3) Plans and estimates of the cost of original construction and completion of the existing distributing system and standby plant used by the Pacific Gas and Electric Company in supplying electrical energy within San Francisco, including easements and other properties and rights owned in San Francisco and used or useful in connection with said system.

The several propositions follow in order:

1. Electrical Distributing System for Moccasin Creek Power Plant

The cost of an electrical distributing system and standby plant sufficient for distributing in San Francisco the electrical energy to be developed at the Moccasin Creek Power Plant of the Hetch Hetchy Project is estimated at \$45,000,000, made up as follows:

Step-down substation at end of transmission line, reducing the transmission voltage to a lower voltage, and cables and conduits for transmitting power at this lowered voltage through the City of San Francisco to substations....	\$ 3,500,000
Distributing substations, conduits, cables, services, meters, poles and conductors.....	30,500,000

Steam standby station.....	6,000,000
Lighting of streets.....	4,500,000
Miscellaneous equipment and headquarters.....	500,000
Total	\$45,000,000

The distributing system covered by the above estimate is shown on the drawing Sheet 1, entitled "Municipal Distributing System, For Full Output of Moccasin Creek Plant."

The steam standby station covered in the above estimate is shown on the drawing Sheet 2, entitled "Municipal Standby Plant, Schematic Arrangement."

The distributing system and standby plant as contemplated in the above estimate and plans referred to, would be competitive with those both of the Pacific Gas & Electric Company and the Great Western Power Company, it has been laid out in accordance with the provisions of the ordinance to distribute the full output of the Moccasin Creek Power Plant of 80,000 k-v-a. installed capacity, amounting to 214,000,000 k. w. h. per annum delivered to the consumers on the basis of 50 per cent load factor.

During the year 1923 the total amount of power delivered to consumers by the Pacific Gas & Electric Company and the Great Western Power Company in San Francisco was 280,372,617 k. w. h.

As pointed out in my report to the Board of Supervisors dated September 11, 1923, "We cannot conceive of actually constructing a complete system such as the estimate was based on as an initial installation, for the very practical reason that there would not be a market to receive all of the power. The market could only be built up slowly if in competition with existing companies; this would take a number of years."

With the foregoing in mind I have planned an initial installation for a distributing system capable of taking care of our Municipal Railway, some of the public buildings, and some of the street lighting, and in addition such industries, business houses, and residences as could be conveniently served by the substations necessary to handle the Municipal Railway load. This initial installation would be such that it could be gradually expanded and extended to conform to the system for complete distribution covered in the foregoing estimate.

The cost of this initial installation is estimated at \$15,000,000, made up as follows:

Step-down station at end of transmission line reducing the transmission voltage to a lower voltage, and cables and conduits for transmitting this lower voltage through the City to substations.....	\$ 3,000,000
Distributing substations, conduits, cables, services, meters, poles, and conductors.....	8,000,000
Steam standby station.....	3,000,000
Street lighting.....	600,000
Miscellaneous equipment and headquarters.....	400,000
Total	\$15,000,000

This initial distributing system is shown on the drawing Sheet 3, entitled "Municipal Distributing System for Initial Development."

The steam standby plant for this initial development would require only one of the 35,000 k. w. generating units shown on the drawing Sheet No. 2.

This initial system, as has been pointed out, will not distribute the entire output of the Moccasin plant, nor will it serve the entire City. The territory which it is planned to serve is that contiguous to the Municipal Railway substations, the location of these substations being shown on drawing Sheet No. 4, entitled "Municipal Distributing System, Municipal Railway Lines," from which the greatest revenue can be derived.

The amount of load which this system would be called upon to distribute initially is problematical; it would include the requirements of the Municipal Railway System to an amount not exceeding 40,000,000 k. w. h. per annum, municipal light and power to the extent of 1,000,000 k. w. h. and street lighting to the extent of 1,500,000 k.w.h.;—or 42,500,000 k. w. h. per annum of municipal load. To this amount should be added such load as can be developed or taken from the present operating utility companies. During the first year the total electrical energy delivered would certainly not exceed 60,000,000 k. w. h. for all purposes. This delivery might reasonably be expected to increase at the rate of 5,000,000 k. w. h. per annum during the first few years. The expense of providing for this increase will range between one and two million dollars annually, depending upon the extent to which the main trunk system and substations have to be extended or built to care for the new business.

The foregoing estimate of the cost of an initial distribution system contemplates the construction new of the works to be included therein. It is entirely possible that in lieu of a part of such new construction it would be possible to acquire from the Pacific Gas & Electric Company or the Great Western Power Company, or both of them, either by voluntary agreement or through eminent domain proceedings, such portions of their plants as could be satisfactorily incorporated into said initial distributing system. In the latter event a portion of the new construction would be unnecessary.

I therefore recommend that if a bond issue be submitted for the purpose of acquiring or constructing such initial plant, its designated purposes be made broad enough to cover construction in whole or in part or acquisition in whole or in part of the works necessary to said system.

II. Original Construction, Great Western Power Company

The cost of original construction and completion of the existing distributing system and standby plants used by the Great Western Power Company in supplying electrical energy to the inhabitants of the City and County of San Francisco as outlined in the ordinance No. 6.013 (New Series) is estimated at \$9,000,000, made up as follows:

Distributing substations, conduits, cables, services, meters, poles, and conductors (including \$800,261, value of Universal Electric and Gas property taken over).....	\$5,500,000
Steam generating stations (including \$305,100, value of Universal Electric and Gas property taken over).....	3,000,000
Miscellaneous utilization equipment (including \$3,488, value of Universal Electric and Gas property taken over).....	200,000
General and Miscellaneous (including \$12,744, value of Universal Electric and Gas Co. taken over).....	300,000
	<hr/>
	\$9,000,000

In view of the fact that Ordinance No. 6,013 (New Series) limits the estimate to the cost of original construction, these figures are based on the reproduction cost of the property, without any deduction being made for depreciation, nor has any amount been included for severance damage. They do not therefore represent the valuation which would be set up for purposes of purchase or sale, or under condemnation proceedings.

The estimate covers, in accordance with the requirements of the ordinance, the existing plant of the company, including one-half the value of the Universal Electric and Gas Company's property taken over by the Great Western Power Company. It also includes certain property used by the company which I do not consider desirable for the City to acquire and which has been excluded in the condemnation proceedings already instituted by the City Attorney's office.

The distributing system of the Great Western Power Company is shown on the drawing Sheet No. 5, entitled "Great Western Power Company's Electric Distributing System," which shows the steam generating stations, the substations, and the territory served. Due to the amalgamation of the Universal Electric and Gas Company's system with that of the Great Western Power Company and the Pacific Gas & Electric Company it has not been possible to show separately the portion of the system acquired from the Universal Electric and Gas Company, as requested in the ordinance.

The primary distribution through a large part of the City is by 11,000 volt overhead circuits. This method of distribution is one which I do not consider desirable on account of the high voltage employed, and is one which the City should not adopt for a distributing system of its own.

The drawing Sheet No. 5 indicates the territory served by the Great Western Power Company. It should be pointed out, however, that the Company does not furnish all of the electric energy used in the territory indicated as served, as the business is divided with the Pacific Gas & Electric Company, which covers the same territory.

III. Original Construction Pacific Gas and Electric Company

The cost of original construction and completion of the existing

distributing system and standby plant used by the Pacific Gas and Electric Company in supplying electrical energy to the inhabitants of the City and County of San Francisco, as outlined in the ordinance No. 6,013 (New Series), is estimated at \$23,500,000, made up as follows:

Distributing substations, conduits, cables, services, meters, poles, and conductors (including \$800,261, value of Universal Electric and Gas Company property taken over).....	\$16,000,000
Steam standby station (including \$305,100, value of Universal Electric and Gas Co. property taken over).....	6,000,000
Utilization and street lighting equipment (including \$3,488, value of Universal Electric and Gas Company property taken over).....	1,000,000
Miscellaneous equipment and office property (including \$12,744, value of Universal Electric and Gas Company property taken over).....	500,000
	<hr/>
	\$23,500,000

These figures, as in the case of the Great Western Power Company's distributing system and for the same reason, are based on the reproduction cost of the property without any deduction being made for depreciation, nor has any amount been included for severance damage.

The estimate does not include property used jointly for gas distribution, nor property and equipment in San Francisco, used in constructing, maintaining, or operating the Company's electric, gas, water, or railway systems outside of the City and County of San Francisco.

The estimate includes certain property used by the Company, which I do not consider desirable for the City to acquire, and which has been excluded in the condemnation proceedings already instituted by the City Attorney's office.

The distributing system of the Pacific Gas and Electric Company is shown on the drawing Sheet No. 6, entitled "Pacific Gas and Electric Company's Electric Distributing System," which shows the steam standby station and substations within the City.

The Pacific Gas and Electric Company now operates and maintains a step-down station in San Mateo County, just south of the southern boundary of San Francisco. This station, which is known as the New Martin Substation, is used to reduce the voltage used in transmission to that of the primary distribution. It is shown in its relation to the San Francisco Distributing System of the Company on Sheet No. 6. Between Newark Substation and the New Martin Substation the Company has a high voltage double circuit transmission line on steel towers constructed along the Bay Shore. Should San Francisco acquire the distributing system of the Pacific Gas and Electric Company within the City limits, the Company would not have further use for either the New Martin Substation or the transmission line. Both the substation and

transmission line would be useful to the City and if not taken over with the distributing system would, without doubt, be a large element in the severance damage allowance.

The estimated reproduction cost of the transmission line and the New Martin Substation is \$1,000,000, which amount should be added to the estimated cost of the distributing system if the transmission line and substation are to be included therein, making the total for the Pacific Gas and Electric Company's distributing system \$24,500,000.

The New Martin Substation and the transmission line are shown on the drawing Sheet No. 7, entitled "Pacific Gas and Electric Company's 110 k. v. Transmission Line and Substation on West Shore of San Francisco Bay."

Plans

Plans of the several distributing systems, standby stations and appurtenant matters designated in the ordinance No. 6,013 (New Series) are presented herewith on eight sheets, each bearing the general title:

PLANS FOR
ELECTRIC DISTRIBUTING SYSTEM
and STANDBY PLANT
CITY AND COUNTY OF SAN FRANCISCO
PREPARED UNDER ORDINANCE NO. 6013
BOARD OF PUBLIC WORKS
M. M. O'SHAUGHNESSY, CITY ENGINEER

Sheet No.	Title
1	Municipal Distributing System, for Full Output of Moccasin Creek Plant
2	Municipal Standby Plant, Schematic Arrangement.
3	Municipal Distributing System for Initial Development.
4	Municipal Distributing System, Municipal Railway Lines.
5	Great Western Power Company's Electric Distributing System.
6	Pacific Gas and Electric Company's Electric Distributing System.
7	Pacific Gas and Electric Company's 110 K. V. Transmission Line and Substation on West Shore of San Francisco Bay.
8	Present and Possible Future Districts Requiring Underground Electric Distribution.

Respectfully submitted,

M. M. O'SHAUGHNESSY,
City Engineer.

The estimate of \$45,000,000 for the construction of a complete new distribution system, and the estimates of the reproduction cost of the two existing systems, were very severely attacked by certain of the Supervisors as being too high and a great deal of publicity was given to this criticism. The findings of the Railroad Commission, however, have since proved that the criticism by the Supervisors was unwarranted,

by bringing in estimates of reproduction cost of the two companies not less but slightly greater than the figures submitted by the City Engineer in the above report.

The valuation of the utility properties was undertaken by the Railroad Commission while the Citizens' Advisory Committee was still wrestling with the problem of finding a method of temporarily disposing of the power. The City Engineer was called upon from time to time to furnish data and information to the Advisory Committee and also, at their request, attended a number of the meetings and conferences on the subject. The situation was becoming very acute as construction work was proceeding at a rate which indicated the completion of the Moccasin plant by about the first of July, 1925.

On March 10, 1925, the Board of Supervisors called for bids, to be opened on March 30, from municipalities, municipal water districts or irrigation districts, covering the purchase of the whole or any part of the energy to be developed at the Moccasin plant. No bids were received.

On April 8, 1925, the Advisory Committee submitted a report reading as follows:

"The Advisory Committee believes, in view of an emergency such as now exists, it is desirable to enter into some form of temporary agreement whereby the City's power could be transmitted and distributed over the lines of the local power companies. In order to avoid conflict with the Raker act, however, and to preserve municipal control, such a transmission and distribution agreement would have to be charged with the following restrictions:

"A: It must be simply an emergency measure of temporary character.

"B: It must provide for its ready discontinuance at the request of the City, upon the acquisition of a municipal distribution system.

"C: Those to whom Hetch Hetchy power is delivered must be listed as the City's customers during the life of the contract and must pay the legally established rates for power received, and regular reports must be made to the City of the amount charged by the power company for such services rendered.

"D: All payments due the power company for service rendered, must be paid in cash and not in electric power, as any electric power given as payment must in turn be resold by the power company. This would in effect be wholesaling the City's power through subterfuge and would therefore tend to place the power grant in jeopardy.

"E: All compensation paid to the power company must be at a fixed or definite rate, so that all increase or loss of income resulting from any cause, shall be solely to the advantage or disadvantage of the City, as the actual owner of the electric energy.

"F: The City must have the right to have transmitted to it such Hetch Hetchy power as it requires for its municipal utilities, paying

the power company a reasonable compensation for its transmission services.

"The Advisory Committee now recommends that, if possible, an arrangement be made with the local power companies to transmit and distribute the City's Hetch Hetchy power crop, in accordance with the restrictions hereinabove set forth.

"In entering into such an arrangement it should, however, be stipulated that any agreement made shall not interfere in any manner with actions already taken by the Board of Supervisors for the acquisition of a municipal distributing system, by purchase or original construction, including a transmission line to San Francisco.

Respectfully submitted,

(Signed)

JAMES D. PHELAN (Chairman,
MATT I. SULLIVAN,
HENRY BOYEN,
CHARLES KENDRICK,
FRANK J. MURASKY."

Following receipt of this report the Board of Supervisors by Resolution No. 23,890, on April 13, 1925, appointed another committee consisting of the Mayor and the Chairmen of the Finance and Public Utilities Committees, directing that they take up negotiations for the temporary disposal of the City's power under conditions not in conflict with the provisions of the Raker act.

Steps were immediately taken to formulate a plan for marketing to the inhabitants of San Francisco the output of the Hetch Hetchy plant through the agency of the existing companies. The City Attorney's office, represented by Mr. John J. Dailey, cooperating with this office, took the matter up with the Great Western Power Company and the Pacific Gas & Electric Company. On account of physical conditions, the number of consumers and the extent of their market in San Francisco, the Pacific Gas & Electric Company appeared to be the only company in a position to distribute the power available from the Moccasin plant.

Again on May 26, 1925, the Citizens Advisory Committee submitted a report to the Mayor as follows:

"The Advisory Committee, at the request of the Mayor, has recently conferred with representatives of the Pacific Gas & Electric Co. concerning the temporary disposal of the electric energy generated on the Hetch Hetchy system.

"The Committee has been impressed by the facts that the electric energy will be available for use within a very short time; that the Raker act forbids the sale of power to private corporations or individuals for resale; and that, if any attempt is made to part with the City's rights, the City would be exposed to a cancellation of its grant in judicial proceedings instituted by the Attorney-General of the United States, upon the request of the Secretary of the Interior.

"The Committee proposed to the officials of the Pacific Gas & Electric Company a plan by which the Hetch Hetchy power might be, without prejudice to the City's rights, distributed over the lines of that company to consumers, to be charged for at existing legal rates, all bills to be collected and accounted for by the Pacific Gas & Electric Company for a stipulated compensation, or a fixed price per unit of power handled, said compensation to the company to be determined by the Railroad Commission of the State of California. The plan proposed is substantially the same as that recently recommended by the Chamber of Commerce, the San Francisco Real Estate Board and the Downtown Association.

"The company's officials have refused to enter into such an agreement. They have made a counter-proposition which involves the sale to the company of the entire output of electric energy generated at Moccasin Creek for the sum of \$2,000,000 per annum, payable in equal monthly installments. This amount, which approximates one-half of one cent per kilowatt hour at Newark, the company has offered to pay subject to the following conditions:

"(a) That the energy consigned from Moccasin Creek power house at Newark shall not be less than 420,000,000 kilowatt hours per annum at a 75 per cent monthly load factor. Payment to the City shall be increased or decreased proportionately as consignment of energy is above or below this amount.

"(b) That if the present established rates for electric energy be increased, the payment of \$2,000,000 to the City as proceeds of said consignment shall be proportionately increased, and if present established rates are decreased the payment of said \$2,000,000 to the City as proceeds of said consignment shall be proportionately decreased.

"By reason of the provisions of the Raker act, which prohibits a sale of the Hetch Hetchy electrical energy to a private corporation or individual for resale, and the refusal of the company's officials to recede from their position, the committee regrets to report that it has been unable to reach an agreement.

"Whether or not any legal and financially desirable arrangement be hereafter made for the temporary disposal of the power, the committee advises that all possible speed be given to the completion of a transmission system from Newark to San Francisco, and a distributing system in San Francisco, which, indeed, is absolutely and legally necessary in order to carry out the provisions of the Raker act and establish the temporary character of any such arrangement, and protect the permanent rights and interests of the City in Hetch Hetchy power.

"And we further advise that, if, in the future, a temporary agreement by the Secretary of the Interior, upon the advice of the Attorney-General for the disposal of electric power is reached, that it first be approved by the United States."

Acting under the instructions of the Supervisors' Committee, the

City Attorney prepared a draft of an agreement which in his opinion was in correct legal form and which did not conflict with any provisions of the Raker Bill. This was submitted to that body without the figures fixing the revenue basis. The Committee thereupon fixed the basis of revenue and the completed draft was formally submitted to the Pacific Gas & Electric Company by the Mayor on June 12, 1925.

The reply of the Pacific Gas & Electric Company made to the Mayor on the same day follows:

"I am just in receipt of your letter of today accompanied by two drafts of agreement embodying the terms and conditions under which the City proposes to make temporary disposal of Hetch Hetchy power through the system of Pacific Gas & Electric Company. My associates and I are giving this draft immediate consideration, but cannot submit to you before Monday morning our complete report thereon.

"There is, however, one feature of the proposed agreement upon which we can answer at once. That is the item of price. The form of agreement submitted fixes a price substantially in excess of \$2,000,000 per annum, whereas we have repeatedly advised you and other representatives of the City that \$2,000,000 per annum for the total output of the Moccasin Creek power house at Newark is the maximum sum we could pay.

"On July 30, 1923, the Board of Supervisors passed a resolution inviting proposals for the total power output of the Hetch Hetchy project under a term contract, not to exceed ten years. That invitation was duly communicated to us, and by our letter of September 9, 1923, we offered \$2,000,000 per annum.

"At the time of the writing of that letter a relative dearth of power made the forthcoming Hetch Hetchy power production more valuable to the company than it now is, and if an offer for that power were now to be made by the company for the first time the offer would be less than \$2,000,000.

"Furthermore, later negotiations disclosed that the City representatives desired not a term contract but a temporary contract, subject to cancellation on short notice.

"Inasmuch, however, as the price of \$2,000,000 was once named, the company determined to adhere to it although all commodities fluctuate in market value from day to day and no one would ordinarily think of being bound to buy or sell on quotations made 20 months past, nor would anyone ordinarily deal at the same price for a temporary contract as for a term contract.

"But in furtherance of our desire and purpose to be helpful to the City in which we have so largely an interest, we submitted to the Mayor's Advisory Committee on May 15, 1925, a proposed form of temporary contract for the purchase of Hetch Hetchy power, which counsel advised the company to be lawful and which the company was prepared to execute with the City. The contract fixed the price at \$2,000,000 per annum, notwithstanding the changed conditions.

"This sum per annum upon the terms stated in the company's proposal of May 15, 1925, to the Mayor's Advisory Committee, or similar terms, or terms akin, is all the worth the company can find in the Hetch Hetchy power, and it is not prepared and it cannot afford to pay any higher amount therefor.

"As you know, our company is a large buyer of power as well as a large producer of power. We are now buying power at many places in Northern and Central California. Our contracts for the purchase of power have been examined and analyzed by competent representatives of the City. In no case do we pay more than we have offered for Hetch Hetchy power. As a rule we pay less.

"Between midnight and morning and on Sundays and holidays, when little or no power is being used, we must pay for the power Hetch Hetchy is then turning out, even though there is no demand for it.

"We are now producing power and delivering it at load centers for less than the price offered for Hetch Hetchy power and can continue to do so. Our Pit River No. 3 plant will be completed next month. That plant will deliver to our system at Newark more power than the Hetch Hetchy output for substantially less money than we have offered for the Hetch Hetchy power.

"The City is not willing to sell us Hetch Hetchy power as and when we need it, but requires us to take all its power; and we are dealing upon that basis. Our offer, therefore, is to take your entire output whether we can use it or not. If we do not take it, we pay for it just the same.

"Please be assured, Mr. Mayor, of our purpose to assist in the present situation to the fullest extent, but we cannot pay more than a fair and adequate price.

"Respectfully yours,

W. E. CREED, President."

This letter did not break off negotiations and by careful study of actual conditions it was possible to draw up the following contract between the Board of Public Works and the Pacific Gas & Electric Company. On June 29 the Board of Supervisors authorized the Board of Public Works to sign the contract which was done by both parties on July 1, 1925:

"AGREEMENT BETWEEN THE CITY AND COUNTY OF SAN FRANCISCO AND PACIFIC GAS AND ELECTRIC COMPANY"

"This Agreement, made and entered into this first day of July, 1925, by and between the Board of Public Works of the City and County of San Francisco, acting for and on behalf of the City and County of San Francisco, a municipal corporation, hereinafter referred to as "City," under authority of the Board of Supervisors granted by Ordinance No. 6684 (New Series), the party of the first part, and Pacific Gas and Electric Company, a corporation, of San Francisco, California, hereinafter referred to as "Company," the party of the second part;

“WITNESSETH:

“Whereas, the City has now completed the construction of the Moccasin power plant as a part of the development of the Hetch Hetchy Project, which plant has a rated capacity of 70,000 kilowatts and is capable of producing approximately 460,000,000 kilowatt hours of electric energy annually, and has also completed the building of a transmission line to the vicinity of Newark in Alameda County of sufficient capacity to transmit and deliver to that point approximately 420,000,000 kilowatt hours after allowance for transmission losses; and

“Whereas, the City has not yet constructed or acquired a transmission line from the point near Newark to the City limits, and has not yet constructed or acquired a distribution system for utilizing the power produced at Moccasin plant and delivering the same for general municipal uses and for sale to consumers of electric energy within the limits of the City and County; and

“Whereas, pursuant to resolutions of its Board of Supervisors looking to the acquisition of a municipally owned electric distribution system, the City has commenced and there is now pending before the Railroad Commission of the State of California, proceedings for the determination by the Commission of the compensation to be paid by the City for the local distribution systems and certain steam plants now owned and operated by the Pacific Gas and Electric Company and the Great Western Power Company of California, respectively, when the same shall be taken over by the City under eminent domain proceedings, or otherwise;

“Whereas, the City has not funds available at the present time with which to purchase or construct a distribution system of its own and it will be necessary to submit a proposition to the people to vote bonds to provide money for that purpose, before a distribution system can be purchased or constructed, and the City cannot well determine whether to purchase one or both of the local distribution systems, or to construct a distribution system of its own until the Railroad Commission determines the amount of compensation to be paid by the City for the taking of either or both of said local distribution systems under the proceeding now pending before the Commission; and

“Whereas, the City intends to complete its power transmission line from Newark to San Francisco and to acquire or construct a distribution system of its own; and

“Whereas, the said Moccasin Power Plant is now in condition to operate at its full capacity of 70,000 kilowatts and unless some temporary arrangement is made between the City and County for the distribution to consumers of the electric energy which can be purchased at said plant during the period that must elapse before the City can acquire, own and operate a distribution system of its own, there will be a great waste of said potential energy and a great loss of potential revenue to the City and its taxpayers; and

"Whereas, the statistical and financial records kept by the City or the Company show the following, viz.:

"1. That the total capacity and possible annual output of energy from the Moccasin plant will not be sufficient to supply all municipal requirements and the demand of consumers in the City and County for electric power and energy although in hours and days of low energy requirement the capacity and output may be more than sufficient to supply said requirements and demands during said hours and days.

"2. That the average transmission and distribution losses of energy from the Newark substation of the Company to the various consumers' meters in San Francisco is 24 per cent of all energy delivered into the system of the Company at Newark for transmission and distribution to consumers in San Francisco.

"3. That 2.383 cents is the average revenue per kilowatt hour received from all classes of consumers of the Company in San Francisco under existing rates based on the experience of the Company for the year 1924.

"III. Now, Therefore, in consideration of the premises and the mutual covenants and conditions herein contained, the parties hereto mutually covenant and agree as follows:

"First: The City hereby employs the Company and the Company accepts employment as temporary distributor for and on behalf of the City of the electric energy to be generated at Moccasin Power House and transmitted to Newark by the City over its own transmission lines. The City agrees to so maintain its Moccasin plant that it will, whenever necessary to do so, carry load up to its full capacity of 70,000 kilowatts, subject to limitations of its forebay storage and to accidents and unforeseen contingencies; and to deliver and consign the entire energy output of its said plant to the Company, save and except such portion thereof as may be reserved for City requirements as hereinafter provided. The Company agrees to accept such consignment of the entire energy output of Moccasin plant, less transmission losses and except such portion as the City shall retain as above and hereinafter mentioned delivered at not to exceed a 75 per cent monthly load factor, to make at its own expense the necessary physical connection of the City's transmission lines with its own system at Newark; to install all necessary equipment, facilities and proper meters for accurately measuring the amount of energy delivered; to transmit so much of said energy through its own system to San Francisco as may be required to light public streets and to meet other municipal needs for electric energy; to supply street railroads and other consumers of such energy in the City; to transform, convert, regulate, distribute and meter the energy sold; to furnish all necessary peak load and steam standby service and collect from consumers of such energy the charges therefor which shall not exceed the lawfully established rates, and make accounting to the City as hereinafter in Paragraph Fifth provided.

"Second: The City agrees that the energy consigned to the Company from the Moccasin plant shall be the entire output thereof, diminished only by transmission and other losses and by such amounts as the City shall require for its own use in the construction or operation of any portion of the Hetch Hetchy Project, and also by such amounts, if any, as the City may be legally required to furnish to irrigation districts or municipalities under the terms of the act of Congress, approved December 19, 1915, known as the Raker Act. Failure or inability of the Company to take at Newark a part of the energy which the City is in a position to deliver to it under the terms of this agreement shall not constitute grounds for deduction in the amount of the revenue to be paid to the City had such energy been received by the Company and sold to consumers, it being understood, however, that the Company is not required to accept the output of the Moccasin plant at a monthly load factor in excess of 75 per cent.

"Third: In order to arrive at the amount which should be realized by it for its Moccasin energy consigned by the City to the Company at Newark under the terms of this agreement for transmission and delivery to consumers, the City has assumed (and the Company for the purposes of this agreement merely, has acquiesced in the assumption) that of the energy consigned and delivered to the Company at Newark and by the Company delivered to consumers in the City and County of San Francisco there would be transmission, substation and distribution losses amounting to 24 per cent of the energy thus consigned and delivered at Newark and therefore 76 per cent of the energy consigned and delivered at Newark should be taken as the true measure of the amount possible of deliverance to consumers.

"Fourth: In order to arrive at the amount which should be realized by it for its Moccasin energy consigned by the City to the Company at Newark under the terms of this agreement for transmission and delivery to consumers, the City has assumed (and the Company for the purpose of this agreement merely, has acquiesced in the assumption) that inasmuch as in the year 1924 under existing rates the average revenue received by the Company from consumers in San Francisco amounted to 2.383 cents per kilowatt hour, such average revenue should be applied to 76 per cent of the energy to be consigned and delivered by the City to the Company at Newark for the purpose in this contract declared.

"Fifth: In order to arrive at the amount which should be realized by it for its Moccasin energy consigned and delivered by the City to the Company at Newark under the terms of this agreement for transmission and delivery to consumers, the City has assumed (and the Company for the purposes of this agreement merely, has acquiesced in the assumption) that the City shall receive for the energy consigned and delivered by it to the Company at Newark 26.935 per cent of 2.383 cents per kilowatt hour for 76 per cent of the energy so consigned and delivered at Newark, and that the Company shall receive 73.065 per cent thereof.

"It is agreed by the City and the Company that the Company shall account for and pay over to the City for the energy so consigned and delivered to it by the City at Newark for transmission and distribution to consumers as provided in this contract 26.935 per cent of 2.383 cents per kilowatt hour for 76 per cent of the energy so consigned and delivered by the City to it at Newark, and the Company shall retain the aforementioned 73.065 per cent as its compensation for services rendered under this contract.

"Sixth: The City shall not be obliged to deliver energy into the system of the Company at Newark, nor shall the Company be obligated to receive such energy at such time as either shall be prevented from doing so on account of accidents, acts of God or fire, making it physically impossible to so deliver or receive energy or on account of strikes, riots, war, or any other cause beyond reasonable power of control of either party. In the event of inability on the part of the City to deliver the said energy at Newark, or inability on the part of the Company to receive the energy at Newark, arising from any of the causes in this paragraph specified, the party so prevented from making such delivery of energy or receiving such energy shall proceed at all possible speed to take the necessary action to enable it to comply with its covenants herein contained.

"Seventh: The net proceeds due the City, namely 26.935 per cent of 2.383 cents per kilowatt hour for 76 per cent of the energy so consigned and delivered at Newark by it to the Company, shall be paid into the Treasury of the City and County of San Francisco by the Company in monthly installments and not later than the 15th day of each month after operation under this agreement commences. The amount of such payment shall be based upon the amount of energy actually delivered into the system of the Company at Newark during the preceding month. In the event of the refusal, failure or inability of the Company to take the available output of the Moccasin plant deliverable at Newark in accordance with the terms of this agreement, then the amount of energy which the City could have delivered shall be the basis of computing such monthly payment. The method for determining this amount shall be covered in the memorandum of technical specifications, details and conditions hereinafter provided for.

"Eighth: Should the present established rates for the sale of electric energy in San Francisco be hereafter increased or decreased by lawful authority, then the amount to be retained by the Company and the amount to be paid to the City under the terms of this agreement shall be proportionately increased or decreased.

"Ninth: Neither this contract nor anything contained herein, nor the prices, rates or charges fixed herein, shall ever be offered or in any manner used as evidence by either said City and County or said Company or any successor in interest of either of them in any court or before any

commission or official of the State of California or the United States of America in any action or proceeding in which said City or any successor in interest shall be a party adversary to said Company, or any successor in interest, other than an action or proceeding between the parties hereto, or their respective successors in interest, or one of said parties and a successor in interest of the other, commenced and prosecuted for the purpose of obtaining a judicial or official interpretation or determination of the legality of this contract or of any provision thereof or for the purpose of enforcing its performance, or recovering damages for its non-performance.

"Tenth: It is expressly recognized that this contract is a temporary arrangement between the parties for distributing the energy output of the Moccasin plant over and through the Company's lines and system during the period that must elapse before the City can construct or acquire a distribution system of its own.

"It is therefore agreed that the contract may be terminated at any time by either the City or the Company upon one day's previous notice in writing to the other.

"Eleventh: It is further understood and agreed that this contract is subject to immediate cancellation upon request or demand of the Secretary of the Interior of the United States should he hold that in his opinion the agreement violates any provisions of the laws of the United States in general, or the Raker Act in particular.

"Twelfth: All of the electric energy to be delivered and received pursuant to the provisions of this contract shall be three phase, 60 cycle, alternating current. The electro-motive force of such energy at the point of delivery shall be approximately 105,000 volts, slight variation in voltage and frequency to be permitted.

"Thirteenth: The Company shall inspect, test and keep in proper repair all meters and accessories at Newark which will be used for measuring the amount of electric energy consigned to the Company under this contract. The said meters shall be kept under joint seals of the City and Company which shall not be broken except in the presence of authorized representatives of both parties. Either party shall have the right at any time to request an inspection or test, and if found necessary, proper adjustment of such meters in the presence of a representative of the other party appointed for that purpose. When such inspection or test is desired, sufficient notice shall be given by the party desiring the test, to permit of the other party having its representative present. The registration of the meters shall be used as the basis of determining the amount of energy consumed hereunder, unless, upon being tested, the meters shall be found to register inaccurately and such inaccuracy shall exceed two per cent (2%). Where the inaccuracy is more than two per cent (2%), but the actual inaccuracy can be approximately determined, the readings of such meters shall be corrected and such corrected reading shall be used as a basis for determining the amount of energy delivered.

Where the registry of the meters cannot be so properly corrected, the amount of energy delivered during such period of inaccurate registry shall be estimated by the engineers for the parties hereto from the average daily plant output of energy during such period, and from any other available and pertinent data.

"Fourteenth: Technical specifications, details and conditions as to the construction of the interconnecting lines and switching apparatus at Newark, and as to the maintenance, repair and operation of the proper generating plant and transmission system of the City shall be agreed upon by the City Engineer of San Francisco and the Vice-President in charge of electrical construction and operation of the Company, and a memorandum of such agreed specifications and operating details shall be filed with and become part of this agreement; provided, that if any changes in said technical specifications or operating details may from time to time become necessary or advisable in the opinion of both of said parties, supplemental memoranda of the same shall be filed, and become part hereof without affecting the remaining terms of the agreement.

"Fifteenth: The recitals hereinabove contained commencing with the words 'Whereas, the City has not completed the construction of the Moccasin power plant,' and ending with the words 'a great loss of potential revenue to the City and its taxpayers; and' are statements made by the City of its purposes and intentions and concerning other matters contained in said recitals. Said recitals are not and no one of them is made by or on behalf of the Company. None of said recitals shall be binding on either of the parties to this agreement in any dispute, controversy or question which may ever hereafter arise in which the same might otherwise be relevant or pertinent.

"In Witness Whereof, the Board of Public Works has caused these presents to be duly executed and signed by its Members, and the Company has caused these presents to be executed by its officers first thereunto duly authorized by resolution of its Board of Directors, a copy of which is hereunto annexed, the day and year first above written.

"BOARD OF PUBLIC WORKS OF THE
CITY AND COUNTY OF SAN FRANCISCO.

By T. A. REARDON,

By D. G. FRASER,

By C. E. STANTON,

Its Members.

Attest:

S. V. Hester,

Acting Secretary.

(Seal)

PACIFIC GAS AND ELECTRIC COMPANY,
A CORPORATION.

Attest:

By F. A. LEACH,

D. A. Foote,

First Vice-President and General Manager.

Secretary.

(Seal)"

In order to insure that no time would be lost in putting the contract into execution through the failure of the Department of the Interior of the Federal Government to sanction the agreement, Chief Assistant Engineer Nelson A. Eckart and Special Attorney John J. Dailey were dispatched from San Francisco to Washington to interview the Secretary of the Interior, and discuss with him the terms of the contract. These gentlemen left San Francisco on June 23, 1925.

The approval of the contract by the Board of Supervisors ended the first stage of a discussion and controversy, bitter at times, which had been going on for a number of years from the time that the Supervisors came to realize that the City was developing one of the major hydro-electric plants of the State. The final conclusion to market the power through one of the corporations on an agency basis was the only logical one at this time. By this means the City will realize a revenue of not less than \$2,000,000 per year under normal circumstances which will help to reduce by that amount the burden on the taxpayer incident to meeting interest charges and other expenditures necessary to complete the project.

Bay Development

Bay Crossing Pipe Line:

The 60-inch riveted steel pipe line from a point near Irvington, Alameda County, to Pulgas Tunnel portal, about four miles west of Redwood City, has been completed with the exception of about 200 feet. This pipe is 19.4 miles long, not including the submarine pipes at Newark Slough and Dumbarton Strait, and is made up of plates from 5/16 inch to 7/16 inch in thickness. This pipe is laid in a right of way, varying from 60 feet to 100 feet in width, owned in fee by the City. The width is sufficient to accommodate two future pipe lines.

From Irvington to Newark, a distance of 6 miles, the pipe is buried in a trench varying in depth from 7 to 9 feet. This portion of the line crosses level, cultivated farm land devoted to dairying and vegetable crops. From Newark to Dumbarton Strait, a distance of 3.1 miles, the land is salt marsh and in this section the pipe is supported on timber trestle. The 60-inch riveted pipe connects with 42-inch castiron submarine siphons crossing Newark Slough and Dumbarton Strait. The submarine siphon at Newark Slough is about 400 feet in length and that crossing the navigable channel at Dumbarton Strait 2770 feet.

At the westerly end of this latter siphon a large hexagonal concrete caisson has been constructed through which the 42-inch castiron pipe passes, connecting to a riveted steel riser pipe inside of the structure. The caisson is 81.5 feet in diameter at its base and extends from elevation -74 to elevation +25. Provision is made in the caisson for three additional 42-inch submarine pipe connections and their connecting risers, to be constructed in the future with need for more water, and which will connect into a manifold at the top. From the section of this mani-

fold at present installed, the 60-inch riveted steel pipe is carried on 36 steel bridge spans, a distance of 3875 feet, to the west shore line of Dumbarton Strait.

The next half mile westerly is salt marsh, flooded by the tides, and in this distance the pipe is supported on timber trestle to the Bay-Pulgas Pumping Station. From this point the pipe line is laid through cultivated lands and improved property, passing through the southwesterly portion of Redwood City, and getting support on the low rolling hills on the north side of Cordilleras Canyon. In this distance the pipe is buried in a trench from 7 to 9 feet deep, excepting at the crossings of nine small gullies in the Cordilleras region, where it is supported on concrete piers and steel bents. The steel pipe at its west end connects with Pulgas Tunnel at elevation 290.5 feet.

The entire length of riveted steel pipe line was tested after installation under a pressure approximately 25% in excess of the working pressure and made absolutely tight.

The greatest care was taken in giving the pipe a coating of Biturine Enamel, applied both outside and inside by a dipping process, at the shop while being fabricated.

The Western Pipe and Steel Company of California under Contract No. 90, furnished and installed this pipe. The work remaining to be done under the contract includes the installation of about 200 feet of pipe on the steel bridge described below, the testing of about $1\frac{1}{4}$ miles of pipe and a few small details.

Dumbarton Strait Bridge:

A bridge, 3,875 feet long, consisting of 36 steel spans supported on concrete piers, and with capacity for two 76-inch pipes, has been constructed from the west shore of Dumbarton Strait to a point near the navigable channel.

Contract No. 95, for constructing the bridge piers, was awarded to Healy-Tibbitts Construction Company, October 19, 1923.

Piers: Each pier, except the east end pier, consists of two reinforced cylinders braced by longitudinal concrete beams and supported on a heavy concrete foundation supported on from 52 to 60 piles. The 36 piers range in height from 25 feet to 51 feet. Construction of the piers was carried on simultaneously at three localities by the following system: A cofferdam of steel or wood sheet piling was driven slightly larger than the pier base. The mud was excavated to a depth of from 10 to 30 feet where fairly stiff blue clay was encountered. Piles spaced at about 3-foot centers were then driven below this elevation from 30 to 50 feet. Tremie concrete to a depth of 2 feet was then placed and after a lapse of five days the cofferdam was pumped out. Piles were cut off to proper height, forms set up, reinforcing steel placed and the concrete piers poured in the dry. After the concrete was set the collapsible forms were removed and the cofferdam removed, to be used on other piers.

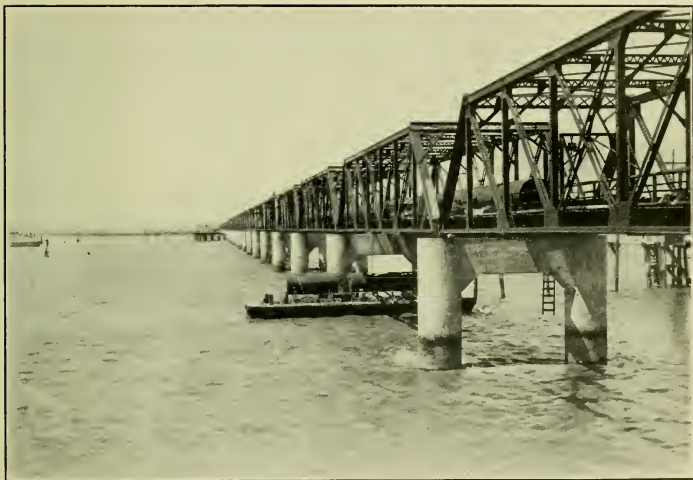
End Pier or Caisson: The east end pier of the steel bridge is a large concrete structure which houses the connections between the submarine pipe under the bay and the riveted pipe on the bridge. It is hexagonal in plan, tapering upward from a base diameter of 81½ feet to a short diameter at the top of 40 feet. Down the central portion a hexagonal open well, 24 feet in short diameter, is constructed to permit of pipe being placed to join the submarine pipes which enter at the base. Four 42 inch pipes pass through the concrete base, providing for the connection of four 42-inch submarine pipes, only one of which is under construction. Additional submarine pipes will be laid as the demand for water increases. This pier is supported on 715 piles, driven into clay and gravel strata, to an average depth of about 100 feet below the water level. Twenty-one concrete cylinders approximately 8 feet in diameter, with connecting webs, form a circular cofferdam within which the remainder of the structure is built, and also serve as an essential part of the pier. Four additional cylinders located inside of the cofferdam form part of the foundation. The pier is 99 feet in height from the base of the concrete cylinders to the caisson top.

The process of building was as follows: The piling in the foundation was driven first. Following this the four interior cylinders were placed by driving steel cylinders as small cofferdams, excavating the clay and sand from within the cylinders, placing wooden forms and reinforcing steel, then pouring the concrete. The exterior or circular ring of cylinders which form the outer wall were then built by a similar process to that used on the interior cylinders, by using a heavy circular steel sheet ⅝ to ⅞ inch in thickness, 9½ feet in diameter, and 81 feet in length, driven 48 feet in the mud, sand and clay, as a cofferdam. The bottom 5½ feet of the cylinder was made to be detached and was left permanently in the firm clay as a base form. After excavating material from the interior of the cylinder, nine piles were driven and a concrete base poured. Above this base, precast concrete forms, 88 inch by 78 inches, and reinforcing steel were placed and the forms filled with concrete. To complete the water tight cofferdam around the main pier, two rows of sheet piling are being driven between each pair of adjacent cylinders. After excavating from the enclosure thus formed, tremie concrete is poured to the top of the cylinders. On top of the ring formed by the 21 concrete cylinders and their connecting webs, a thin circular wall 5 feet in height will be built from elevation + 1.0 to elevation + 6.0. On completion of the cofferdam, the mud and clay will be excavated from the interior of the cofferdam by using centrifugal pumps and jets. After placing a layer of rock, 1 foot in depth on the excavated foundation, a layer of tremie concrete 10 feet thick will be poured. After this concrete has set, water will then be slowly removed from within the cofferdam and the remainder of the pier constructed in the dry.

Under Contract No. 95 all piers except the end pier were completed in November, 1924. In addition, to June 30, 1925, the following work

had been done: all but 40 piles driven for foundation of the end pier; all of the 25 concrete cylinders constructed; 16 of the 21 webs between cylinders of the cofferdam constructed.

Steel Bridge Superstructure: Spanning the concrete piers above described, a steel bridge of 36 spans is being erected by the United States Steel Products Company under Contract No. 93. Each of the 36 spans is 105 feet long, 21 feet wide and designed to carry two steel pipes each 76 inches in diameter. The total weight of the spans is 1761 tons. The members fabricated in an eastern shop were erected to form complete spans on a wharf in San Francisco. The complete individual spans were then floated to the piers on barges at high tide and lowered into position by four hydraulic jacks mounted on the barge. The water supply pipe is supported on wooden saddles resting on the steel floor beams,



DUMBARTON BRIDGE, HETCH HETCHY AQUEDUCT, BAY CROSSING DIVISION
H. H. W. S.

5-foot diameter pipe on steel bridge of 36 spans supported on concrete piers, 107'6" center to center.

which are spaced 15 feet apart. Roller bearings are provided under one end of each span, alternate piers providing roller bearings and fixed bearings. Expansion joints are provided in the pipe line located at each roller bearing pier, and the pipe is anchored to each fixed bearing pier. A two foot walkway with steel handrailing is provided on each side of the 60 inch pipe now to be installed on the bridge. On June 30, 1925,

35 of the spans were erected, the remaining or outer span awaiting completion of the bridge seat on the end caisson.

Trestles for Pipe:

Three and six-tenths miles of trestle to support the 60-inch steel pipe line across the marsh land, adjacent to the Bay, have been built under Contract No. 96 by Leonard F. Youdall. This trestle is in three sections; the first from a point near Newark to Newark Slough, 9,000 feet in length; the second from Newark Slough to Dumbarton Strait, 7,400 feet in length; and the third from Dumbarton Strait to Bay-Pulgas Pumping Plant, 2,600 feet in length. The trestle consists of 943 two-pile bents, spaced 20.56 feet apart, the piles penetrating from 50 to 80 feet in the mud and clay. On this pile bent, a low timber bent is framed from the mud line to high tide line. A wood saddle resting on the cap of the bent supports the pipe line. Bolts and other steel work are galvanized to withstand the action of salt water. Creosoted piles are used at all places where the piling is exposed above the mud line. The trestle on curve is provided with a sliding saddle to take care of pipe expansion, but on tangent sections the pipe is firmly anchored with concrete anchors supported on pile foundations. Seven concrete anchors were constructed under this contract ranging in size from 45 cubic yards to 112 cubic yards. The contract price for this work amounted to \$192,195.52.

Pipe Covering:

Contract No. 108 for constructing wood cover over portions of the pipe line was awarded to J. W. Carpenter, January 23, 1925. This work embodied building a cover over the 3.1 miles of 60 inch riveted pipe supported on trestle between Newark and Dumbarton Strait. The cover consists of one inch redwood lumber supported on a pine frame. It is painted with two coats of paint. This contract was completed at a cost of \$16,765.77.

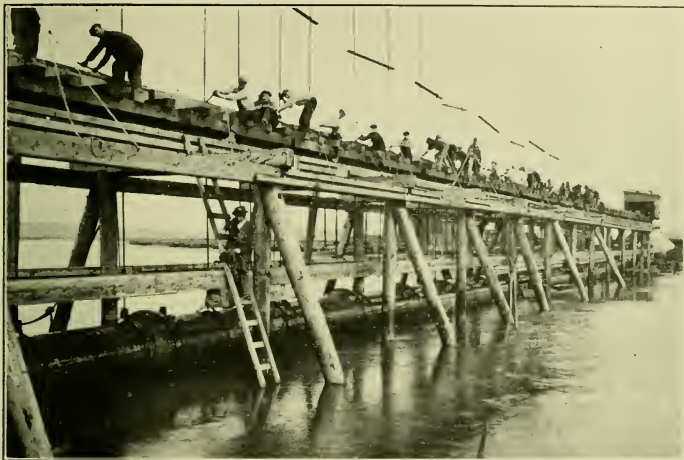
Submarine Siphons:

Submarine pipe, 42 inches in diameter, of cast iron with ball and socket joints, is to be installed in the crossing of the navigable channel and adjacent deep water of Dumbarton Strait for a distance of about 2,770 feet and has been laid across Newark Slough for a distance of 400 feet.

The cast iron pipe was furnished under Contract No. 101 by the United States Cast Iron Pipe and Foundry Company. The order included 263 pieces of flexible joint pipe 2 inches thick, in 12-foot laying lengths, each weighing about 6½ tons, and about 20 special pieces. The total weight was 1,766 tons. Delivery was completed on March 20, 1925, at a total cost of \$208,496.98.

Contract No. 105, construction of submarine pipe lines, including digging the trench, placing broken rock bed, and appurtenant structures, together with the laying of the submarine pipe, was awarded August 22,

1924, to Healy-Tibbitts Construction Company, for an estimated price of \$343,230.00. The first work undertaken under this contract was the Newark Slough crossing. This pipe line was placed by lowering from a temporary trestle. On September 22, 1924, driving of piling was commenced and on June 30, 1925, all pipe at Newark Slough had been placed but not backfilled or final test made. The system used in laying this pipe, which covers a distance too short for a cradle to work in, was to erect a temporary trestle of two-pile bents straddling the desired position



NEWARK SLOUGH SUBMARINE PIPE LINE. HETCH HETCHY AQUEDUCT.
BAY CROSSING DIVISION, U. S. W. S.

42-inch castiron flexible jointed pipe being lowered into trench excavated beneath slough.

of the pipe, with a platform supported slightly above high water, on which the pipe was assembled and the lead joints poured and calked. Over the submarine pipe a track was supported on the pile bents and a short car, mounted on two axles, placed over each joint of pipe. A heavy strap was placed around each end of the 12 foot length of pipe and from this a long threaded rod connected to the car above. Each car supported a length of pipe weighing approximately $6\frac{1}{2}$ tons. To lower the pipe, the supporting nut on the car was turned and the joints deflected vertically to fit the prepared bed which had been excavated at the time the trestle was being erected.

On the Dumbarton Siphon, work was started excavating trench near the end caisson, in January, 1925. On June 30, 1925, 1,200 feet of trench

had been excavated. The trench is excavated in blue mud, blue and yellow clay, and sand with a small amount of fine gravel, and ranged in depth from 10 to 20 feet. It has a width of 12 feet at the bottom of the pipe and a pay width of from 72 feet to 132 feet at the top. For a distance of 168 feet, where a horizontal curve is placed in the line, the system adopted for placing pipe was similar to that used at Newark Slough, lowering from a temporary trestle. In the first 252 feet east of the end caisson, a submerged trestle consisting of two-pile bents, at 12 foot intervals, with caps and stringers to support the submarine pipe, was built at a level from 5 to 10 feet below the mud line. Along the horizontal curve, brace piles were driven and a tremie concrete casing poured around the pipe and anchored to the brace piles. To connect this section of the pipe to the pipe set in the concrete caisson wall it was necessary for divers to make an underwater joint by calking lead wool to the amount of 411 pounds into the joint.

The leaded joints, poured above the water, are calked by forcing small lead cylinders through holes in the perimeter of the bell or outer section of the joint. In each joint 140 pellets $\frac{5}{8}$ inch in diameter by $1\frac{3}{4}$ inches long, having a total weight of 31 pounds, are used. This calking fills the space caused by shrinkage of the 380 to 400 pounds of poured lead, which has a temperature of about 750 degrees at the time of pouring it into the joint. After completing the calking the joints are tested under hydrostatic pressure, using a double diaphragm machine which holds the water by pressing rubber gaskets to the sidewalls of the pipe. All joints so far tested have been found water tight under a pressure of 170 pounds per square inch. The submarine pipe is coated inside and outside with Biturine priming coat and Biturine enamel applied hot with a brush. Up to June 30, 1925, 570 lineal feet of submarine pipe had been placed at Newark Slough and Dumbarton Strait. Great care had to be exercised in laying this pipe so as not to conflict with the 16 inch Spring Valley pipes laying just north.

Bay-Pulgas Pumping Plant:

Under Contract No. 94, two centrifugal pumps with a combined capacity of 25 million gallons per day have been furnished by De Laval Steam Turbine Company. These pumps, electrically driven, are direct-connected to 500 horsepower motors furnished by the General Electric Company under Contract No. 104. This equipment is installed at Ravenswood to act as a booster in handling the water from Niles Reservoir to Crystal Springs Reservoir, under the agreement with the Spring Valley Water Company for use of the Bay Crossing Division pipe line. The Spring Valley Water Company at its own expense has installed a third unit identical with the other units, which increases the capacity of this plant from 25 to 32 million gallons daily. A pump house, 36 feet by 47 feet, with concrete foundation, has been erected on the pipe line right of way to house this equipment.

SHEET 4											
CONTRACT NO.	TITLE OF CONTRACT	DATE OF AWARD	DATE OF SIGNING CONTRACT	TIME ALLOWED IN DAYS	DATE OF ACCEPTANCE	TOTAL PAYMENTS			ELAPSED TIME FROM AWARD TO PAYMENT IN DAYS	REMARKS	CONTRACT NO.
						CONTRACT ITEMS	EXTRAS & DEDUCTIONS	TOTAL AMOUNT PAID			
Col. 1.	Col. 2.	Col. 4.	Col. 5.	Col. 6.	Col. 7.	Col. 8.	Col. 9.	Col. 10.	Col. 11.	Col. 12.	Col. 13.
TOTALS BROUGHT FORWARD						2,395,956.60	+ 83,490.91 - 18,016.71	2,461,430.80			
61	Construction of Hetch Hetchy Appurtenant Works	Aug. 1, 1919.	Aug. 12, 1919.	900	June 30, 1923	6,105,307.51	+ 15,499.35 - 314,138.68	6,186,668.18	1416	Figures in Cols. 10, 11, 12 are for dam with siphon spillway, contractor furnishing all materials. Figures for overflow spillway were lower.	61
62	Furnishing & delivering 18" Air Pipe	June 11, 1919.	June 28, 1919.	75	July 31, 1919.	5,224.20	- 234.80	4,989.40	33	Minus \$136.30 acct. lugs substituted for clinch bands.	62
63	Furnishing & delivering Refrigerating Machine Equipment	June 13, 1919.	July 9, 1919.	60	Oct. 24, 1919.	5,715.00		5,715.00	107	18 days extension.	63
64	Furnishing & delivering Self-Dumping Side Plates	July 9, 1919.	July 28, 1919.	18	Sept. 15, 1919.	2,913.00	- 22.75	2,900.25	49	30 days extension granted acct. charges in deliveries made by City Eng. \$27.75 deducted for labor performed by City.	64
65	Furnishing & delivering Station Pump for Shaft	July 30, 1919.	Aug. 14, 1919.	100	Mar. 19, 1920.	2,267.50		2,267.50	216	30 days extension granted acct. labor trouble.	65
66	Furnishing & delivering 47" x 90" Side Gate Hetch Hetchy Dam	Mar. 5, 1920.	May 19, 1920.	Feb. 28, 1921	Feb. 24, 1922	121,000.00	3,724.35	124,724.35	747	Extra \$3,724.35 to cover Bonus, Test Pcs. Freight. \$800 paid to R. Hunt for inspection.	66
67	Furnishing & delivering 33" x 40" Side Gate Hetch Hetchy Dam	June 4, 1920.	June 9, 1920.	June 30, 1921	Jan. 20, 1922	170,000.00	4,929.22	174,929.22	225	Bids of Mar. 24 & Apr. 21 rejected acct. excessive price. Extra to cover Bonus, Test Pcs. & freight.	67
68	Furnishing & delivering 57" x 40" Side Gate Hetch Hetchy Dam	Mar. 19, 1920.	Mar. 26, 1920.	Feb. 28, 1921	Nov. 2, 1921	173,100.00	4,080.13	177,180.13	553	Extra \$4,080.13 to cover Freight. \$1680. paid to R. Hunt for inspection.	68
69	Furnishing & delivering 37" x 40" Side Gate Hetch Hetchy Dam	Apr. 2, 1920.	Apr. 14, 1920.	Feb. 28, 1921	Apr. 27, 1921	98,500.00	7,373.18	105,873.18	378	Extra \$7,373.18 to cover Freight & Bonus	69
70	Furnishing & delivering Electric Travel	Dec. 14, 1922	Jan. 8, 1923	Mar. 3, 1923	Aug. 5, 1923	30,660.00		30,660.00	203		70
71	Furnishing & delivering Station Pump for Second Garroft	July 30, 1919.	Aug. 7, 1919.	85	Mar. 19, 1920.	1,702.00		1,702.00	235	Lowest Bid. rejected acct. error in estimate, 140 days extension acct. labor trouble.	71
72	Furnishing & delivering 18" Air Pipe	Aug. 11, 1919.	Aug. 15, 1919.	710	Nov. 11, 1919.	8,102.10		8,102.10	88		72
73	Furnishing & delivering Standard Wrought with couplings & Tie Plates	Aug. 15, 1919.	Sept. 10, 1919.	15	Sept. 11, 1919.	6,478.50		6,478.50	17	12 days extension acct. labor trouble.	73
74	Furnishing & delivering Tie Plates	Oct. 8, 1919.	Oct. 21, 1919.	10	May 1, 1920.	4,496.63		4,496.63	198	185 days extension acct. labor trouble.	74
75	Placing, tamping ballast in the Hetch Hetchy	Oct. 10, 1919.	Oct. 16, 1919.	30	Dec. 17, 1919.	3,478.13	- 527.04	2,951.09	63	Contract called for 4 miles. About 17 miles completed, contractor released from further work. \$517.04 deducted for unfinished surfacing & freight charges due City.	75
76	Furnishing & delivering 24" Air Pipe	Jan. 30, 1920.	Feb. 6, 1920.	155	Jan. 25, 1922	12,451.10	12,353.40	24,804.50	353	Extra \$12,451.10 for 4970 ft. of pipe 5 3/8 inch bands, authorized by Bd. of Wks.	76
77 C	Construction of Tunnels in Mtn. cost-plus-fee	May 3, 1920.	Mar. 3, 1920	1000		8,757,844.52	See note	8,757,844.52		Cost-plus-fee Contract.	77 C
78	Furnishing & delivering Electric Traction Line Conductors	Jan. 15, 1923	Jan. 31, 1923	Jan. 1, 1924		141,948.10		141,948.10			78
79 A	Furnishing & delivering Water Wheels Moccasin Creek Plant.	Apr. 20, 1922	May 5, 1922	Aug. 3, 1925	Apr. 20, 1925	247,662.60		247,662.60			79 A
79 B	Furnishing & delivering Valves for Moccasin Creek Power	Apr. 20, 1922	May 5, 1922	Feb. 21, 1925		34,942.58		34,942.58			79 B
80	Furnishing & delivering Electric Generator Accessories for Moccasin Creek Power	May 1, 1922	May 11, 1922	Aug. 3, 1925	Nov. 5, 1924	253,188.60		250,188.60			80
TOTALS						18,580,183.47	+ 113,361.19 - 383,601.99	18,324,942.67			
EXPLANATION						Includes payments on uncompleted contracts.					
H.H. - Hetch Hetchy Mtn. - Mountain division R.R. - Hetch Hetchy Moc. - Moccasin Creek											

4

Posted to June 30 1975

SHEET 5

CONTRACT NO.	TITLE OF CONTRACT	DATE OF AWARD	DATE OF SIGNING CONTRACT	TIME ALLOWED IN DAYS	DATE OF ACCEPTANCE	TOTAL PAYMENTS			ELAPSED TIME FROM DATE OF AWARD TO DATE OF ACCEPTANCE IN DAYS	REMARKS	CONTRACT NO.
						CONTRACT ITEMS	EXTRAS & DEDUCTIONS	TOTAL AMOUNT PAID			
Col. 1.	Col. 2.	Col. 14.	Col. 13.	Col. 16.	Col. 17.	Col. 18.	Col. 19.	Col. 20.	Col. 21.	Col. 22.	Col. 23.
TOTALS BROUGHT FORWARD						\$18,580,183.47	\$+130,361.79 -385,601.99	\$18,324,943.27			
81	Furnishing & erecting transformers, and accessory equipment Moccasin Creek	Aug. 18, 1922	Sept. 13, 1922	352		360,605.75		360,605.75			81
82	Furnishing, erecting and erecting steel work for Moccasin Creek	Feb. 23, 1923	Mar. 10, 1923	127	Jan. 20, 1924	61,408.85		61,408.85	324		82
83	Furnishing & erecting dump cars, motor, Mountaineer	Apr. 6, 1921	Apr. 9, 1921	76	June 24, 1921	\$3,450.00	+ \$150.00	\$3,640.00	76		83
84	Furnishing & erecting air pipe for tunnel ventilation	Feb. 7, 1921	Mar. 10, 1921	120	Jun. 22, 1922	16,726.06	13,257.61	35,983.67	463		84
85	Constructing Pulgos Tunnel	June 23, 1922	July 5, 1922	500	Aug. 27, 1924	738,429.23		738,429.23			85
86	Furnishing, erecting a platform bridge at Sixbit the Hetch Hetchy	July 28, 1922	Aug. 12, 1922	150	Apr. 10, 1923				241		86
87	Concrete abutments and piers for Sixbit Gulch of the Hetch Hetchy	July 28, 1922	Aug. 12, 1922	106	Oct. 30, 1922	6,300.00		6,300.00	79	See Note Below	87
88	Grading road the relocation H.H.R.R. at Sixbit	July 28, 1922	July 31, 1922	60	Mar. 16, 1923				228		88
89	Furnishing & erecting steel reinforcement aluminum coils Moccasin Creek	Jan. 26, 1923	Feb. 5, 1923	331	Oct. 8, 1924	388,299.68		388,299.68			89
90	Constructing Crossing Pipe H.H. Aqueduct	May 18, 1923	June 2, 1923	620		2,169,909.01		2,169,909.01			90
91	Furnishing & erecting penstock accessories Moccasin Creek	May 28, 1923	I-June 2, 1923	I-220 II-200	July 9, 1924	211,756.20 1,017,770.47	\$21,000.00 (Bonus)	211,756.20 1,038,770.47		I = Upper portion. II = Lower portion.	91
92	Furnishing, erecting and driving of across San Francisco Bay or Dumbarton	May 14, 1923	June 5, 1923	60	June 13, 1923	3,277.20	\$500.00 (Bonus)	3,777.20	14		92
93	Furnishing, erecting steel superstructure pipe line of Dumbarton	Aug. 17, 1923	Sept. 17, 1923	215		306,261.85		306,261.85			93
94	Furnishing, erecting and installing centrifugal	Mar. 31, 1924	Apr. 22, 1924	150	Apr. 24, 1925	5,808.29		5,808.29			94
95	Constructing structures bridge over Dumbarton Stra	Oct. 19, 1923	Nov. 8, 1923	Apr. 1, 1924		734,848.85		734,848.85			95
96	Constructing trestles for Crossing Pipe	Apr. 30, 1924	May 15, 1924	200		185,000.00		185,000.00			96
TOTALS						\$24,790,074.91	\$+171,269.40 -385,601.99 Includes uncompleted payments on contracts	\$24,575,742.32			

Posted to June 30, 1925.

CONTRACTS - HETCH HETCHY WATER SUPPLY

SHEET 5

CONTRACTS — HETCH HETCHY WATER SUPPLY																					
Contract No.	GENERAL DESCRIPTION	LOCATION OF WORK, OR LOCATION FOR WHICH MATERIALS WERE PURCHASED	AMOUNT OF BOND FOR PERFORMANCE	DATE OF OPENING BIDS	NO. OF BIDS	HIGHEST BID	LOWEST BID	SUCCESSFUL BID	CONTRACTOR	CONTRACTOR'S ADDRESS	DATE OF AWARD	DATE OF SIGNING CONTRACT	TIME ALLOWED IN DAYS	DATE OF ACCEPTANCE	TOTAL PAYMENTS			REMARKS			
															CONTRACT ITEMS	EXTRAS & DEDUCTIONS	TOTAL AMOUNT PAID				
Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 13A	Col. 14	Col. 15	Col. 16	Col. 17	Col. 18	Col. 19	Col. 20	Col. 21	Col. 22	Col. 23
85	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Moccasin Creek Power Plant.	\$33,000.00	Aug. 9, 1912	2	\$3,723.33	\$3,452.27	\$3,452.27	Westinghouse Electric and Manufacturing Co.	East Pittsburgh, Pa. 1st Nat'l Bank Bldg., C.F.	Aug. 10, 1912	Sept. 13, 1912	352		\$3,582.13		\$3,582.13				
86	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Moccasin Creek Power Plant.	\$5,000.00	Feb. 21, 1913		6,400.00	6,072.00	6,072.00	Union Construction and Drydock Co.	Key Route Basin Oakland, Cal.	Feb. 23, 1913	Mar. 10, 1913	117	Jan. 20, 1914	6,400.00		6,400.00	324			
87	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Mountain Division tunnels.	\$500.00	Mar. 15, 1913	7	3,810.00	3,490.00	3,490.00	Joshua Hendy Iron Works.	75 Fremont St.	Apr. 6, 1913	Apr. 3, 1913	78	June 14, 1913	\$3,490.00	+ \$150.00	\$3,640.00	76			
88	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Mountain Division tunnels.	\$500.00	Feb. 2, 1913	2	\$1,858.34	\$1,726.00	\$1,726.00	Western Pipe and Steel Co. of California.	444 Market St. S.F.	Feb. 7, 1913	Mar. 10, 1913	110	Jun. 27, 1913	\$1,726.00	\$1,257.61	\$2,983.61	463			
89	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Through Pulgas Ridge in San Mateo County near Redwood City.	\$13,000.00	June 8, 1912	4	\$79,390.00	\$65,280.00	\$65,280.00	Grant Smith and Co.	708 Balboa Bldg. S.F.	June 23, 1912	July 3, 1912	300	Aug. 27, 1914	738,429.23		738,429.23				
90	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Siskiyou Gulch [Don Pedro Reservoir]	\$7,250.00	July 26, 1912	5	\$74,574.50	\$63,312.00	\$63,312.00	Union Construction and Drydock Co.	Key Route Basin Oakland, Cal.	July 28, 1912	Aug. 12, 1912	130	Apr. 11, 1913				241			
91	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Siskiyou Gulch [Don Pedro Reservoir]	\$8,750.00	July 26, 1912	5	\$44,890.00	\$37,940.00	\$37,940.00	Schultz Construction Co.	Geary & Park Sts. S.F.	July 28, 1912	Aug. 12, 1912	106	Oct. 31, 1912		6,300.00	6,300.00		See Note Below		
92	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Siskiyou Gulch [Don Pedro Reservoir]	\$3,000.00	July 26, 1912	6	\$16,690.00	\$13,000.00	\$13,000.00	M. J. Lyons	512-514 Mission St. S.F.	July 28, 1912	July 31, 1912	60	Mar. 10, 1913				220			
93	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Transmission line from Moccasin Creek P.H. to Irvington.	\$9,000.00	Jan. 24, 1913	1	\$34,224.00	\$34,224.00	\$34,224.00	Aluminum Company of America	Pittsburgh, Pa.	Jan. 28, 1913	Feb. 5, 1913	331	Oct. 8, 1914	\$38,299.60		\$38,299.60				
94	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Livingston, Alameda Co. to Pulgas Tunnel.	\$48,332.25	May 9, 1913	3	\$396,345.00	\$233,861.25	\$233,861.25	Western Pipe and Steel Co. of California.	444 Market St. S.F.	May 10, 1913	June 2, 1913	610		2,629,909.91		2,629,909.91				
95	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Moccasin Creek Power Plant.	\$41,214.00	May 23, 1913	3	\$24,512.25	\$15,204.75	\$15,204.75	Western Pipe & Steel Co. of California.	444 Market St. S.F.	May 24, 1913	June 2, 1913	710	July 9, 1914	\$11,158.80		\$11,158.80				
96	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Driving test piles at locations of piers for Dumbarton pipe bridge.	\$10,000.00	May 8, 1913	5	\$5,920.00	\$3,614.00	\$3,614.00	Healy T. B. Co. Construction Co.	24 Pine St. S.F.	May 14, 1913	June 5, 1913	80	June 19, 1913	\$3,771.20	\$500.00 (Bonus)	3,771.20	14			
97	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Dumbarton Straits	\$31,100.00	Aug. 8, 1913	6	\$38,909.30	\$28,611.00	\$28,611.00	J. J. Steel Products Co.	1414 Bldg. S.F.	Aug. 17, 1913	Sept. 11, 1913	213		306,261.85		306,261.85				
98	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Bay Pulgas pumping plant	\$1,750.00	Mar. 18, 1914	3	\$1,800.00	\$1,283.00	\$1,283.00	De Laval Steam Turbine Co.	81 Beale St. S.F.	Mar. 31, 1914	Apr. 22, 1914	130	Apr. 24, 1913	5,808.25		5,808.25				
99	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Dumbarton Strait.	\$240,000.00	Oct. 17, 1913	1	\$1,848,175.00	\$1,912,483.00	\$1,912,483.00	Healy T. B. Co. Construction Co.	24 Pine St. S.F.	Oct. 18, 1913	Nov. 5, 1913	Apr. 1, 1914		734,848.85		734,848.85				
100	Reinforcing, delivering & erecting a plate girder under Siskiyou Gulch on the Northern Railroad.	Over morasses between Newark and Bay Pulgas pumping plant.	\$67,100.00	Apr. 30, 1914	6	\$244,300.00	\$187,643.00	\$187,643.00	Leonard F. Voudoull	1414 Bldg. S.F.	Apr. 30, 1914	May 13, 1914	200		185,000.00		185,000.00				
TOTALS															\$4,300,014.31	\$171,289.40	\$4,471,303.71				

Note on Contracts 86, 87, 88: This work made necessary by action of Turlock & Modesto Irrigation Districts in constructing Don Pedro Dam. Actual expenditures under these contracts were: Contr. 86, contract items total \$24,630.43; Contr. 87, contract items, \$36,374.39; extras \$208.11; total \$36,583.56. Contr. 88, contract items total \$2,597.88; Irrigation Districts paid \$1,511.88 of this expense; City paid \$6,300.00.

CONTRACT NO.	TITLE OF CONTRACT	DATE OF AWARD	DATE OF SIGNING CONTRACT	TIME ALLOWED IN DAYS	DATE OF ACCEPTANCE	TOTAL PAYMENTS			REMARKS CONCERNING THE CONTRACT TO ACCEPTANCE DATE	REMARKS	CONTRACT NO.
						CONTRACT ITEMS	EXTRAS & DEDUCTIONS	TOTAL AMOUNT PAID			
Col. 1.	Col. 2.	Col. 14.	Col. 15.	Col. 16.	Col. 17.	Col. 18.	Col. 19.	Col. 20.	Col. 21.	Col. 22.	Col. 23.
TOTALS BROUGHT FORWARD						\$24,790,074.91	\$-111,229.40 -385,601.99	\$24,515,742.32			
97	Furnishing & erecting butterfly valve for Moccasin Cr. Pipe	Jan. 26, 1924	Feb. 3, 1924	135	June 10, 1925	26,728.00		26,728.00			97
98	Furnishing & erecting electric transmission line insulators	Dec. 21, 1923	Jan. 4, 1924	To July 1, 1924	May 20, 1925	90,750.66		90,750.66			98
99	Furnishing & erecting electric transmission line towers	Jan. 11, 1924	Jan. 25, 1924	To July 1, 1924		266,526.40		266,526.40			99
100	Furnishing & erecting gate valves for Crossing Division	Mar. 5, 1924	Mar. 18, 1924	120		17,822.62		17,822.62			100
101	Furnishing & erecting flexible joint pipe	Mar. 10, 1924	Mar. 20, 1924	To Sept. 20, 1924		184,356.01		184,356.01			101
102	Furnishing & erecting insulating bus for Moccasin Plant	Mar. 26, 1924	Apr. 9, 1924 Apr. 10, 1924	To Sept. 1, 1924	Nov. 26, 1924 Feb. 18, 1925	12,937.50 2,648.25		12,937.50 2,648.25		*Sum of bids on 6 items.	102
103	Furnishing & erecting electric transmission line hardware	Apr. 11, 1924	Apr. 24, 1924 Apr. 29, 1924	To Aug. 1, 1924	Mar. 27, 1925 Dec. 15, 1924	7,739.58 4,897.80		7,739.58 4,897.80		*Sum of bids on 6 items.	103
104	Furnishing & erecting electric material Bay-Pulgas Pump	May 7, 1924	May 22, 1924	130	Apr. 24, 1925	6,790.00		6,790.00			104
105	Construction of submarine	Aug. 22, 1924	Oct. 15, 1924	180		29,548.34		29,548.34			105
106	No Contract										106
107	Furnishing, delivering, erecting steel structure, Moccasin Plant	Nov. 6, 1924	Nov. 19, 1924	85	June 15, 1925	30,314.79		30,314.79			107
108	Construction of wire on portions of Crossing Division	Jan. 23, 1925	Feb. 3, 1925	90		8,591.27		8,591.27			108
TOTALS						\$25,419,726.13	\$-171,269.40 -385,601.99	\$25,265,333.54			

CONTRACTS - HETCH HETCHY WATER SUPPLY

CONTRACTS -- HETCH HETCHY WATER SUPPLY																						
LINE NO.	TITLE OF CONTRACT	LOCATION TO WHICH CONTRACTED	GENERAL DESCRIPTION	LOCATION OF WORK, OR LOCATION FOR WHICH MATERIAL ETC. WAS PURCHASED	AMOUNT OF BIDS FOR CONTRACTUAL PERFORMANCE	DATE OF OPENING BIDS	NO. OF BIDS	HIGHEST BID	LOWEST BID	SUCCESSFUL BID	CONTRACTOR	CONTRACTOR'S ADDRESS	DATE OF AWARD	DATE OF SIGNED CONTRACT	TIME ALLOWED IN DAYS	DATE OF ACCEPTANCE	TOTAL PAYMENTS			REMARKS	PAGE NO.	
																	CONTRACT TERMS	ESTIMATED DEDUCTIONS	TOTAL AMOUNT PAID			
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15	Col. 16	Col. 17	Col. 18	Col. 19	Col. 20	Col. 21	Col. 22	Col. 23
BIDS FORWARDED FROM SHEETS																						
97	Furnishing & delivering valves for Power Plant	Mac	Three 18" valves with operating mechanisms & electric rams	Head of Moccasin Creek Penstock	10,000.00	Jan. 3, 1924	6	13,700.00	53,900.00	26,728.00	26,728.00	Joshua Hendy Iron Works	75 Fremont St. S.F.	Jan. 25, 1924	Feb. 3, 1924	135	June 1, 1925	26,728.00		26,728.00		97
98	Furnishing & delivering electric transmission line hardware	Transm. Line	26000 standard units and 1,500 heavy duty units for 154 Kv	Transmission line, Moccasin P.H. to Newark	50,000.00	Dec. 8, 1923	5	120,710.00	83,407.50	83,407.50	Westinghouse Electric & Manufacturing Co.	1st Nat'l Bank Bldg., S.F.	Dec. 21, 1923	Jan. 4, 1924	104 days	May 20, 1925	90,750.66		90,750.66		98	
99	Furnishing & delivering electric transmission line hardware	Transm. Line	About 510 double circuit towers	Do	125,000.00	Jan. 3, 1924	2	392,676.00	274,224.00	274,224.00	Pacific Coast Steel Co.	Same Bldg., S.F.	Jan. 8, 1924	Jan. 17, 1924	10 days	May 20, 1925	266,506.40		266,506.40		99	
100	Furnishing & delivering gate valves for Bay Crossing Division	Bay Crossing	2-42" 1-36" and 4-20" gate valves	Bay Crossing Pipe Line and Bay-Pulgas Pump Station	3,675.00	Feb. 20, 1924	2	21,292.00	16,335.00	16,335.00	Union Machine Co.	834 Branson St. S.F.	Mar. 2, 1924	Mar. 18, 1924	120		17,822.62		17,822.62		100	
101	Furnishing & delivering flexible joint cast iron pipe	Bay Crossing	4518 tons flexible joint C.I. pipe for submarine siphons	Dumbarton Strait and Newark Slough	58,500.00	Feb. 20, 1924	3	272,824.25	196,802.00	196,802.00	U.S. Cast Iron Pipe and Foundry Co.	Burlington, N.J.	Mar. 13, 1924	Mar. 23, 1924	10 days	May 20, 1925	164,356.01		164,356.01		101	
102	Furnishing & delivering insulating bus supports for Moccasin Power Plant	Mac	Post insulators for outdoor switching station	Moccasin Power Plant	4,400.00	Mar. 13, 1924	9	24,952.00	3,435.56	3,435.56	Ohio Brass Co. Newark-New Electric Co.	Hubert Bldg., S.F.	Mar. 18, 1924	Apr. 8, 1924	20 days	Nov. 18, 1925	12,937.50		12,937.50	*Sum of bids on 6 items	102	
103	Furnishing & delivering electric transmission line hardware	Transm. line	Hooks and clamps for insulators and cable	Transmission line M.C.P.H. to Newark	2,700.00	Apr. 2, 1924	5	12,916.00	12,410.00	12,410.00	Westinghouse Electric & Manufacturing Co.	1st Nat'l Bank Bldg., S.F.	Apr. 8, 1924	Apr. 24, 1924	16 days	Mar. 27, 1925	7,739.58		7,739.58	*Sum of bids on 6 items	103	
104	Furnishing & delivering electric motors for Bay-Pulgas Pumping Plant	Bay Crossing	Two 500 HP induction motors and starting apparatus	Bay-Pulgas Pump Station	1,800.00	Apr. 10, 1924	2	7,754.00	6,700.00	6,700.00	General Electric Co.	Rialto Bldg.	May 1, 1924	May 22, 1924	150	Apr. 24, 1925	6,700.00		6,700.00		104	
105	Construction of submarine pipe lines	Bay Crossing	Laying pipe furnished under Contract 101.	Dumbarton Strait and Newark Slough	66,646.00	Aug. 20, 1924	3	409,620.00	343,230.00	343,230.00	Healy-Tibbitts Construction Co.	64 Pine St. S.F.	Aug. 27, 1924	Oct. 15, 1924	180		23,540.34		23,540.34		105	
106	No Contract entered into.																				106	
107	Furnishing, delivering and erecting steel bus structure Moccasin Power Plant	Mac.	Moccasin Power Plant Bus Structure	Moccasin Power Plant	7,100.00	Nov. 5, 1924	4	21,640.00	23,640.00	23,640.00	California Steel Co.	Hobart Bldg. S.F.	Nov. 6, 1924	Nov. 19, 1924	85	June 8, 1925	30,314.79		30,314.79		107	
108	Construct of wood cover on portions of Bay Crossing Pipe Line	Bay Crossing	Cover over 5 foot pipe on trestle	Newark to Ravenswood over marsh land	8,440.00	Jan. 15, 1925	7	44,000.00	38,000.00	38,000.00	J. W. Carpenter	398 Tennessee Ave. Palo Alto, Calif.	Jan. 21, 1925	Feb. 3, 1925	90		8,031.27		8,031.27		108	
TOTALS									1,134,735.00	1,134,735.00							814,776.45	111,228.66	23,66,381.64			

**Expenditures on Hetch Hetchy Project
for Fiscal Year Ended June 30, 1925**

Water Construction

Acct. No.	Primary Accounts	Amount
General Expenditures		
2002	Lands, water rights and rights of way.....	\$ 55,584.18
2003	Rentals, U. S. Government.....	15,000.00
2004	Legal expenses.....	11,342.76
2005	Hydrography	3,034.09
2006	City office administration.....	42,524.61
2007	City Office engineering	78,911.50
2008	State compensation insurance fund.....	2,009.75
2009	Taxes	7,147.00
2010	Miscellaneous construction expenditures.....	1,680.15
2012	Unamortized discount on securities.....	261.78
2101	Groveland office administration.....	45,990.70
2102	Groveland hospital-buildings and equipment.....	90.24
2104	Groveland hospital-operating expenses.....	40,462.42
2110	Groveland dwellings.....	4,745.63
2111	Groveland warehouse.....	6,001.33
2112	Groveland permanent water supply.....	15,821.98
2113	Groveland rigging equipment.....	428.67
2124	Groveland stable and garage equipment.....	37,070.58
Total		\$ 351,047.39

Hetch Hetchy Division

2205	Dam and appurtenances.....	\$ 9,519.48
2206	Clearing reservoir.....	4.60
2226	Telephone lines.....	24.37
Total		\$ 9,539.25

Mountain Division—Tunnel Construction

2402	Engineering	\$ 31,487.62
2403	Camps	907.71
2404	Roads, trails and tramways.....	2,455.48
2405	Adits	878.81
2406	Shafts	37,520.73
2407	Tunnels—City's forces	38,918.22
2407	Tunnels—Construction Co. of North America (Contract No. 77C)	637,629.79
2408	Early Intake C. & C. Aqueduct.....	700.00
2409	South Fork Crossing, Excavation.....	4,019.82
2410	South Fork Crossing, Concrete Piers	3339.37
2411	South Fork Crossing, Piping and Valves.....	52,547.87
2426	Telephone lines.....	19.20
2427	Camp maintenance.....	307.38
Total		\$ 809,242.00

Italics indicate credit.

Expenditures on Hetch Hetchy Project.

Water Construction—(Cont.)

Acct. No.	Primary Accounts	Amount
Foothill Division		
2701	Preliminary Investigations and Surveys.....	\$ 4,663.78
2702	Engineering	28.73
2704	Roads, trails and tramways.....	467.11
2708	Tuolumne River Crossing.....	2,275.34
	Total	\$ 7,434.96
Early Intake Diversion Works		
2902	Engineering	\$ 5,488.79
2903	Camps	192.74
2904	Roads, trails and tramways.....	2,381.73
2905	Dam and appurtenances.....	36,006.20
2906	Spillway	20,596.97
2907	Tunnel construction.....	61,012.64
2908	Canal construction.....	13,846.00
2909	Headgates, blow-off valves, etc.....	250.00
2926	Telephone lines.....	29.15
2927	Camp maintenance.....	767.09
	Total	\$ 140,571.31
Mather Sawmill		
3003	Camps	\$ 20.00
3026	Telephone lines.....	3.54
3027	Camp maintenance.....	68.06
3070	Operating expenses.....	1,244.00
	Total	\$ 1,295.60
Mum Sand Pit		
3101	Plant and equipment.....	\$ 8,796.96
3170	Operating expenses.....	9,403.11
	Total	\$ 606.15
San Joaquin Division		
3302	Engineering	\$ 11.95
3305	Lands and rights of way.....	4,553.34
	Total	\$ 4,565.29
Coast Range Division		
3401	Preliminary Investigations and surveys—Total.....	\$ 30.00

Italics indicate credit.

Expenditures on Hetch Hetchy Project.**Water Construction—(Cont.)**

Acct. No.	Primary Accounts	Amount
Boarding and Commissary Expense		
4000	Boarding houses (City forces)	\$ 219,373.36
4500	Commissary supplies.....	2,313.72
4510	Commissary expense.....	1,015.13
Total		\$ 222,702.21
5000	Material and Supplies	\$ 268,225.88
5010	Material and Supplies, Misc. expenses {	
5000	Material and Supplies, Suspense.....	593,240.00
Total		\$ 325,014.12

Bay Development

6001	Field administration and engineering.....	\$ 7,545.89
6002	Lands and rights of way.....	2,268.72
6007	City office administration and engineering.....	14,357.77
6009	Taxes	1,172.76
6102	Newark Section, Engineering.....	4,067.31
6107	Newark Section, Trestle for Pipe Line (Contract No. 96)	183,276.41
6202	Ravenswood Section, Engineering.....	13,331.05
6207	Ravenswood Section, Sub- and superstructure across Dumbarton Straits (Contract Nos. 93 and 95)	585,640.83
6208	Ravenswood Section, Flexible Pipe Line (Contracts Nos. 101 and 105)	234,106.10
6302	Redwood Section, Engineering.....	385.69
6307	Redwood Section, Pipe Line Bay Crossing. (Contract No. 90)	595,656.15
6308	Redwood Section, Gate Valves (Contract No. 100)....	18,121.62
6309	Redwood Section, Pump Plant, Electric Motors (Contract Nos. 94 and 104)	16,807.43
6310	Redwood Section, Pump Plant Buildings.....	7,668.19
6402	Peninsular Section, Engineering.....	538.08
6407	Peninsular Section, Pulgas Tunnel (Contract No. 85)	88,190.72
Total		\$1,773,134.72

Gross Expenditures, Water Construction, 1910 Fund..\$2,995,154.76

Under the terms of Contract No. 77C (Acct. No. 2407) the Contractor is charged for all materials, power and transportation services fur-

**Expenditures on Hetch Hetchy Project.
Water Construction—(Cont.)**

Acct. No.	Primary Accounts	Amount
	nished by the City. These charges are included as expenditures as herein set forth against the contract, and deducted as listed below, as such charges are not covered directly by actual cash expenditures.	
	Difference in Hospital dues.....	\$ 3,663.64
	Power furnished.....	27,645.33
	Transportation furnished.....	61,935.81
		<u>93,244.78</u>

Net expenditures, Water Construction, 1910 Fund..\$2,901,909.98

**Water Construction—1925 Bond Fund
Foothill Division**

2701	Investigations and surveys.....	\$ 3,004.32
2722	Materials and supplies	593,240.00
2790	Bond expenses	<u>4,167.00</u>

Net Expenditures, Water Construction, 1925
Bond Fund.....\$ 600,411.32

**Power Construction
Primary Accounts**

2008	State compensation insurance fund (undistributed)	
	Total	\$ 15,719.71

Lake Eleanor Division

2304	Roads, trails and tramways.....	1,522.79
2305	Dam and appurtenances.....	436.14
2306	Clearing reservoir.....	49.00
2326	Telephone lines.....	<u>16.57</u>
	Total	\$ 2,024.50

Priest Division

2502	Engineering	\$ 8,318.42
2503	Camps	376.11
2504	Roads, trails and tramways.....	276.98
2505	Dam and appurtenances.....	<i>14,458.83</i>
2506	Clearing reservoir.....	1,590.92
2507	Outlet or power tunnel.....	507,283.68
2526	Telephone lines.....	3.00
2527	Camp maintenance.....	<u>143.29</u>
	Total	\$ 503,533.57

Italics indicate credit.

Expenditures on Hetch Hetchy Project.**Power Construction—(Cont.)**

Acct. No.	Primary Accounts	Amount
Moccasin Creek Division		
2602	Engineering	\$ 19,631.83
2603	Camps	115,859.62
2604	Roads, trails and tramways	1,480.49
2605	Lands and rights of way	50.96
2606	Penstocks (Contracts Nos. 91 and 97).....	402,867.50
2607	Power Plant, buildings and structures.....	100,455.72
2608	Power Plant, hydraulic equipment (Contracts Nos. 79 and 79A)	36,123.66
2609	Power Plant, electrical equipment (Contracts Nos. 80, 81, 102 and 107).....	257,663.91
2613	Power Plant, miscellaneous equipment.....	45.00
2626	Telephone lines.....	23.99
2627	Camp maintenance.....	7,109.58
2628	General equipment.....	1,614.63
2691	Concrete store plant.....	974.50
2692	Stable and garage expense.....	11,807.74
2693	Locomotive crane expense.....	4,980.09
2695	Machine shop expense.....	17,307.35
2696	Carpenter shop expense.....	562.29
2697	Blacksmith shop expense.....	3,078.45
2698	Materials and supplies.....	65,543.74
2699	Materials and supplies—expense.....	4,336.40
	Total	\$ 905,454.33
Lower Cherry Power Development		
2818	Transmission line equipment	\$ 656.22
2820	Transmission line transformers and devices.....	3,129.00
2826	Telephone lines.....	4.40
2870	Operating expenses.....	25,237.29
	Total	\$ 21,456.47
Power Transmission System		
3201	Preliminary investigations and surveys.....	\$ 2.95
3202	Engineering	60,247.61
3203	Camps	16,329.22
3204	Roads, trails and tramways.....	14,743.13
3205	Lands and rights of way.....	13,945.98
3209	Materials and supplies.....	3,118.10
3213	Miscellaneous electrical productive equipment.....	13,611.81
3214	Poles and fixtures (Contract No. 99).....	489,423.87
3215	Overhead system (Contracts Nos. 78, 89, 98, 103)....	346,342.74
3216	Clearing transmission line.....	1,517.88
3220	Transformers and devices.....	14,653.68
	Total	\$ 967,700.77
	Total Net Expenditures, Power Construction.....	\$2,415,889.35

Expenditures on Hetch Hetchy Project.**Hetch Hetchy Railroad**

Acct. No.	Primary Accounts	Amount
Investment Account, Additions and Betterments..	\$2,275.93	
Investment Account, Materials and Supplies.....	8,353.66	6,077.73
Operating Expenses		203,403.08
Total Expenditures, Railroad.....	\$	197,325.35

Miscellaneous Credits

During the fiscal year the following amounts have been received from sales of material, refunds, transfers, etc., and deposited with the City Treasurer to the General Hetch Hetchy 1910 Bond Fund and herein credited to the various appropriate accounts, thereby reducing expenditures to net figures:

Material and Supplies, Water Construction.....	\$	56,046.08
Material and Supplies, Power Construction.....		3,203.28
Materials and Supplies, Railroad.....		2,389.46
State Compensation Insurance Fund.....		25,938.03
Value of materials transferred from 1910 to 1925 funds.....		593,240.00
Total amount credited to the foregoing accounts.....	\$	680,816.85

Receipts from Operations (Not Included in the Foregoing)**Water Construction**

2002 Crocker-Amazon, San Miguel Tracts, Rentals.....	\$	2,823.95
2002 Mather, Rentals.....		100.00
2103 Groveland Hospital, Receipts.....		20,220.76
2109 Groveland Dwellings, Receipts.....		1,742.50
3040 Mather Sawmill, Receipts.....		1,139.02
4000 Boarding Houses, City's Forces, Receipts.....		162,199.67
4000 Boarding Houses, Contractor's Forces, Receipts.....		96,085.27

Total Receipts, Water Construction (deposited to 1910 Bond Fund).....\$ 284,311.17

Power Construction

Sale of Power, Total Receipts, Power Construction.....	\$	57,746.47
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Railroad Operation

Freight Revenue.....	\$	62,420.39
Passenger Revenue.....		14,370.44
Mail Revenue.....		2,851.89
Miscellaneous Revenue.....		208.97
Total Receipts, Railroad Operation.....	\$	79,851.69

Italics indicate credit.

Summary of Expenditures and Receipts—Hetch Hetchy Project**Expenditures**

Water Construction, 1910 Fund.....	\$2,901,909.98	
Power Construction, 1910 Fund.....	2,415,889.35	
Railroad Construction & Operations, 1910 Fund	197,325.35	\$5,515,124.68
Water Construction, 1925 Fund.....		600,411.32
		<hr/> \$6,115,536.00

Receipts

Water Construction, Deposited to Hetch Hetchy Fund.....	\$ 284,311.17	
Power Construction, Deposited to Hetch Hetchy Operative Revenue Fund.....	57,746.47	
Railroad Operations, Deposited to Hetch Hetchy Operative Revenue Fund.....	79,851.69	\$ 421,909.33
		<hr/>
Total Net Expenditures for year 1924-1925		\$5,693,626.67
Total Net Expenditures prior to July 1, 1924		36,535,231.09
		<hr/>
Total Net Expenditures to June 30, 1925		\$42,228,857.76

Addenda**Non-Revenue Services, Hetch Hetchy Railroad**

Credited to the Railroad in report to the Railroad Commission for year ended December 31, 1924, for services not included in the foregoing receipts:

Water and Power Construction Services.....	\$ 287,470.29	
Railroad Operating Services.....	105.84	
		<hr/> \$ 287,576.13

Interest Received on Bay Development Expenditures

	Principal	Interest
April 18, 1922, to May 31, 1924.....		\$ 58,232.05
June 1, 1924, to April 17, 1925.....	\$4,796,086.43	170,451.54
		<hr/>
Transferred to Bond Interest Redemption Fund		\$ 228,683.59
July 1, 1925, to June 30, 1929.....	\$5,000,000.00	
Transferred to 1910 Bond Fund.....		\$ 883,390.64

Expenditures and Receipts—Hetch Hetchy Project.**Addenda—(Cont.)****Receipts from Water Crop**

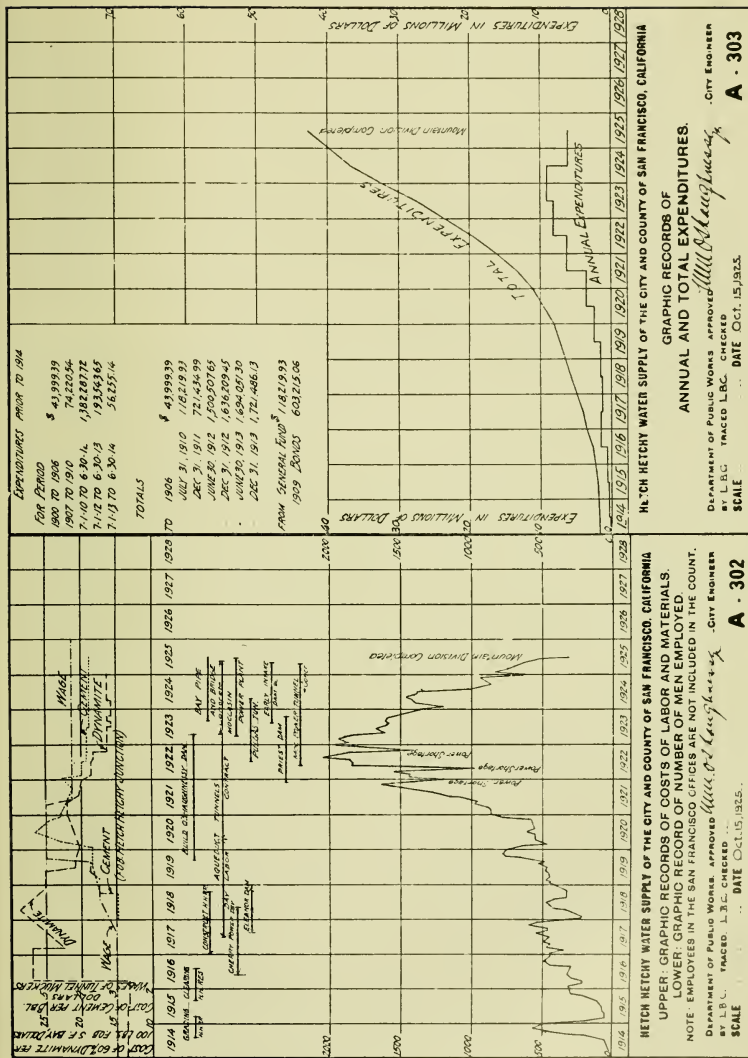
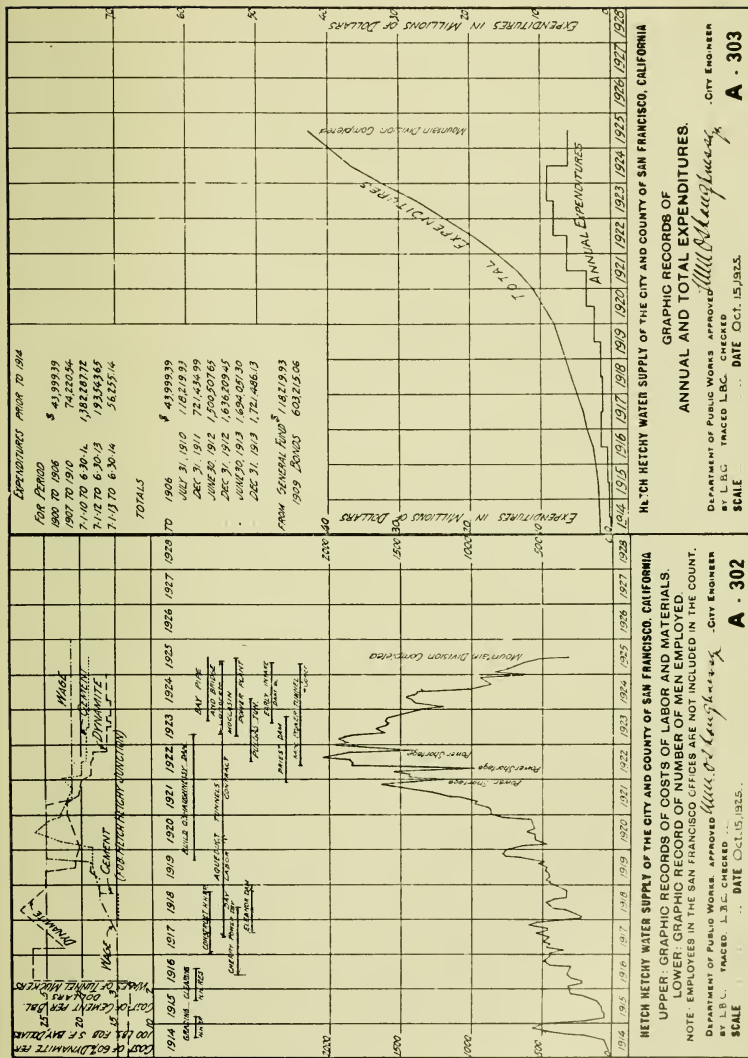
Waterford Irrigation District.....	\$ 750.00
Turlock Irrigation District.....	90,000.00
Modesto Irrigation District.....	30,375.00
<hr/>	
Transferred to Hetch Hetchy Operative Fund	\$ 121,125.00
<hr/>	

Hetch Hetchy Operative Revenue Fund

Total	\$1,905,935.80
Transferred to Bond Interest Fund.....	\$ 620,000.00
Transferred to Hetch Hetchy 1910 Fund.....	886,650.97
Transferred to P. G. & E. and G. W. P. Co.'s Evaluation	207,899.43 1,714,550.40
<hr/>	
Balance available (November 10, 1925)..<	\$ 191,385.40
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Contractual Liabilities

Cont. No.	Contractor	Object of Expenditure	Amount of Contract	Amount due June 30, '25
78	Anaconda Copper Mining Co., Transmission Line....	\$	195,000.00	\$ 53,051.90
90	Western Pipe & Steel Co., Pipe Line Bay Crossing..		2,300,000.00	130,090.99
93	U. S. Steel Products Co., Superstructure Steel Bridge..		332,912.08	26,650.23
95	Healy Tibbitts Constr. Co., Substructure Steel Bridge.....		1,250,000.00	512,470.89
100	Union Machine Co., 20" to 42" Gate Valves.....		18,335.00	512.38
105	Healy Tibbitts Constr. Co., Submarine Pipe Line.....		360,000.000	330,451.66
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Balance due on Contract				\$1,053,228.05
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